Resurrecting a Command Set Transmitter

Add a piece of military history to your station.

Jim Hanlon, W8KGI

The late '40s through the early '60s was a great time for an impecunious kid to get into ham radio. So much military surplus equipment was available that it was possible to get on the air for about $25 and a little creative scrounging, earnable in a couple of weeks of cutting grass or shoveling snow. By far the most affordable and plentiful surplus units were the Command Sets, a series of World War II era aircraft transmitters and receivers. At least 1.45 million were built, so it seemed they were in never-ending supply.[1] They were used for transmitters and receivers on 80 and 40 meters, "converted" to cover every band from 160 through 6, made into VFOs, FM exciters, mobile rigs, SSB transmitters, "Q-5ers," triple conversion receivers, crystal controlled Novice rigs and more. They were cheap, rugged and reliable, and every ham had at least a couple of them somewhere in the shack.

You can still find Command Sets under the tables and out on the ground at many swap fests and also on the Internet auction sites. With a little work, you can get them on the air and have your very own, 65 year old vintage station. This article will explain how to renovate a transmitter. Elsewhere in this issue you'll find an article by Phil Salas, AD5X, that describes a receiver conversion.[2]

The most common Command Set transmitters are the BC-696 or T-19 covering 3 to 4 Mc, the BC-457 or T-20, 4 to 5.3 Mc, the BC-458 or T-21, 5.3 to 7 Mc, and the BC-459 or T-21, 7 to 9.1 Mc. (Back then the radios are labeled in megacycles [Mc], not megahertz.) The ones between 80 and 40 meters can easily be pulled into our bands, so any one you can find will be acceptable for your vintage rig. Just about every one you find these days will already have been converted, but if you happen upon an unmolested one please get it into the hands of a collector who will gladly trade you two or three perfectly useful converted ones for it!

Both the BC-series Army Air Forces and the T-series Navy transmitters are essentially the same, using a 1626 Hartley VFO driving a pair of 1625s (12 V 807s) in parallel as a final amplifier and with a 1629 magic eye tube and crystal in a calibrator circuit.

Figure 1 shows the schematic of the BC-459.[3] The Navy rigs differ only in that they use parallel feed B+ to the final amp plates and their power plug has a different pin-out.

I will describe my conversion process starting with an unmodified 80 or 40 meter transmitter. You can check your rig against my method and the schematic in Figure 1 and modify it as necessary to make it work for you. Then I'll cover the out-of-band rigs in one additional step.

Basic Conversion

The basic conversion is quite simple. You have a few wiring changes to make, and you have to decide how you are going to power and key the rig.

Power

The Command Set likes to be fed as follows.

The 1626 oscillator works well with 200 to 300 V, preferably but not necessarily regulated. My BC-457 draws 33.8 mA at 278 V in this circuit. The 1625 screens are also happy with 250 to 300 V, mine pulling 10.1 mA at 278 V, and they can be fed if you wish through a series resistor or a voltage divider from any available B+ supply. The oscillator can be fed from a series pair of voltage regulator tubes (VR150/VR105 or two VR105s) with a dropping resistor from the oscillator/voltage regulator tube junction to a higher voltage point set for 40 mA to flow through the voltage regulator tubes with no current flowing to the oscillator.

The 1625 plates will run on anything from the same voltage as their screens up to as much as 750 V. You will want to meter either the final plate or cathode current so

[1]Notes appear on page 42.

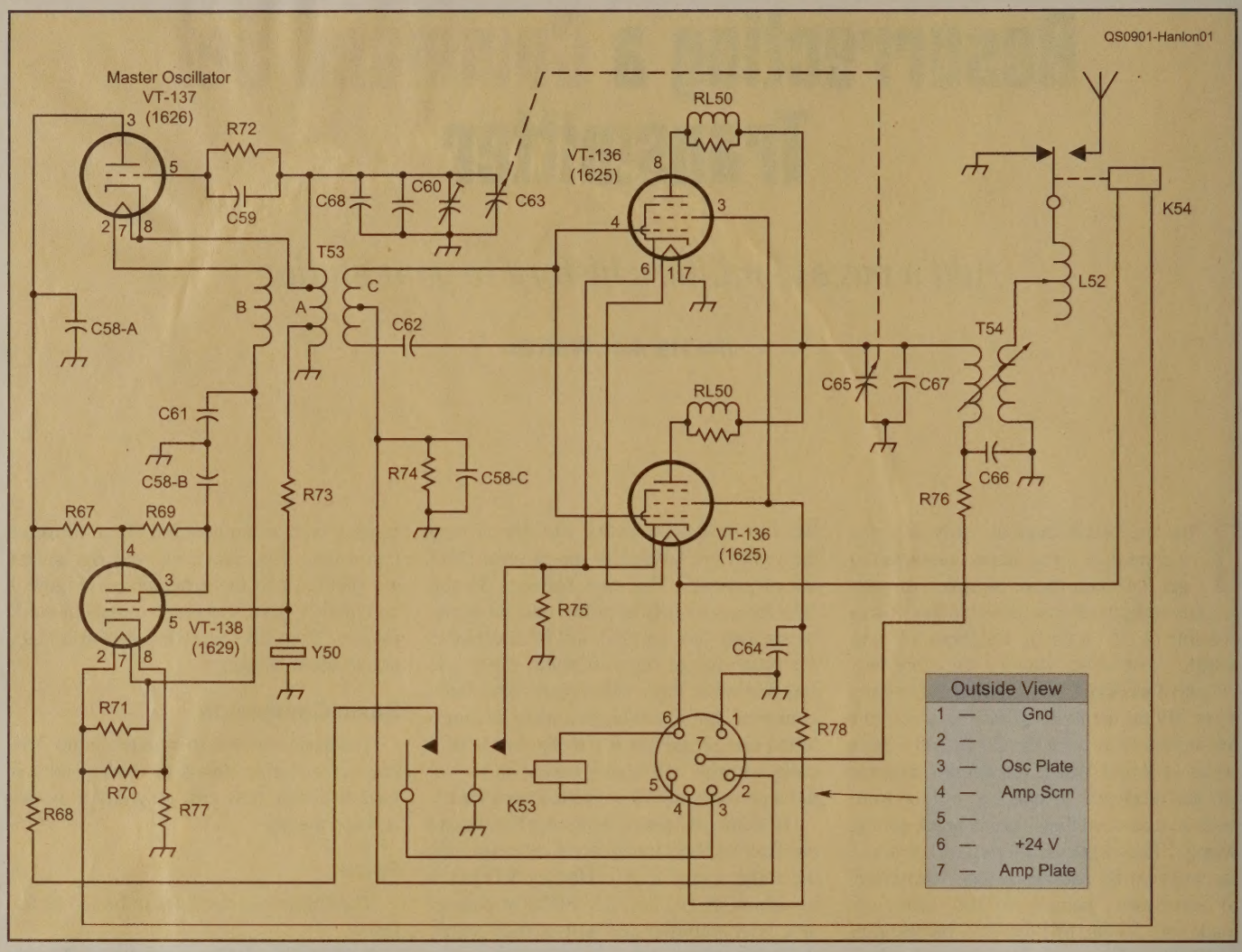


Figure 1—A schematic diagram of a BC-459 transmitter.

C58A, B, C — 0.05 µF.
C59 — 180 pF.
C60 — Master oscillator pad.
C61 — 0.006 µF.
C62 — Fixed value, neutralization.
C63 — Master oscillator tuning.
C64 — 0.002 µF.
C65 — PA Tuning.
C66 — 0.01 µF.
C67 — PA pad.
C68 — 3 pF.
C69 — 50 pF.
K53 — Transmitter selector relay.
K54 —Transmitter output relay.
L52 — Antenna loading coil.
R67, R72, R75 — 51 kΩ.
R68, R76 — 20 Ω.
R69 — 1 MΩ.
R70— 1 kΩ.
R71 — 126 Ω.
R73, R74 — 15 kΩ.
R77 — 390 Ω.
R78 — 51 Ω.
RL50 — Parasitic suppressors.
T53 — Oscillator coils.
T54 — Amplifier coils.
Y50 — Crystal.

you'll know the power input to the final. The 1625 pair is rated up to 200 mA, but max power output and best keying will occur at less plate current, and not necessarily simultaneously.

The filaments as wired were meant to run on 25.2 V dc at 0.7 A. Since we won't be using the relays K53 and K54, you can run the filaments on ac, either 24 V as wired or 12 V if you rewire them in parallel. The 1629 calibrator circuit won't work if you use ac, unless you make another change; but that doesn't affect the transmitter operation at all and we usually didn't bother with it in the '50s.

You also have to decide how to get the power leads into the transmitter. There are racks that hold the transmitters and make connection to their rear power sockets, but they are pretty much "unobtanium" these days. We usually replaced the original power socket with an octal plug or socket or simply soldered wires into the power socket's holes.

If you are starting from scratch, a good choice for your power supply would be one of the Heathkit HP-23 series. They provide somewhere between 250 and 275 V dc, about 750 V dc and 12.6 V ac for filaments, and they can usually be acquired for less than you would pay for new power supply parts. If you already have some parts in your junk box, an old television set transformer, for example, you can get creative about building your own power supply. Consult any vintage *ARRL Handbook* for specific ideas, and look in particular at the "Economy Power Supply" circuit in which a single transformer is used to give two high voltage outputs, one at 0.9 times the end-to-end voltage of the high-voltage winding and the other at half that amount.

Keying

Keying the final cathodes and running the oscillator continuously was probably the most popular way to run CW with a Command Set. My contemporaries often mounted a key jack on the front panel opposite the small tuning knob. I usually brought the cathode lead out on the power socket. My BC-457 has a borderline click when I key it this way, so I use a filter consisting of a 2 H, 100 mA, 100 Ω power supply filter choke (almost any available power supply

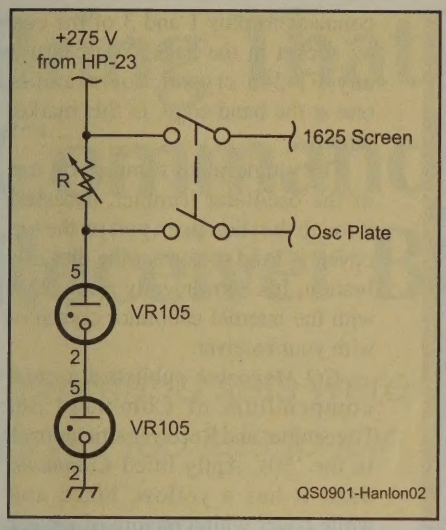


Figure 2 — Here's one method to connect an HP-23 power supply and voltage regulator (VR) tubes to supply regulated voltage to the Command Set oscillator and the 1625 screens.

choke would do), paralleled with a 0.1 μF, 400 V capacitor in series with the hot key lead. Don't forget the capacitor! Without the capacitor the choke will build up an amazingly high voltage across itself when you break the current through it.

Figure 2 shows how to connect an HP-23 and voltage regulator tubes to supply regulated voltage to the oscillator and to power the 1625 screens. Note the switch that silences the oscillator and disables the screens on receive. This switch could be converted into a DPST keying relay if you would rather not have the oscillator running continuously when transmitting.

Internal Changes

Now that you have the power supply and keying settled, the only thing left is a few internal changes and you'll be ready to go

The first thing is to get rid of the relays. K53 under the chassis by the 1625 sockets switches the final cathodes and the oscillator plate. We used to just pull it out and hard wire the connections, but you can just wire across it or jam it closed with a toothpick. Also under the chassis, you may find an open-wound resistor in series with the 1625 plate feed, R76 in the diagram. It is right in front of the 1625 sockets. This little fellow acts like a low current fuse; I generally blew it when I tried to run more than the government-approved 25 W with the transmitter. If it's still there, save yourself some trouble and replace it or parallel it with a piece of wire.

You will also want to go up top, in front, and hard wire the variable link inside the 1625 plate coil directly to the antenna connector, bypassing the loading coil and antenna relay. You can leave the coil and the relay in place, but we won't be using them electrically unless you have an end-fed long wire that you'd like to load without using a transmatch. You might also want to replace the antenna connector with a coax jack while you're there.

Another thing topside is to take a small file and cut back one of the two metal stops on the fiber cog wheel that turns the final link. There is one stop that limits the link at its vertical, minimum-coupling position and a second stop that prevents the link from turning into a full, horizontal, maximum-coupling position. If you want to run more than 25 W or so (and what red-blooded ham doesn't?), file down this second stop and free up the link to turn all the way to the horizontal. You also might add another turn or so in series with the link on the outside of the plate coil if you still need a little more loading.

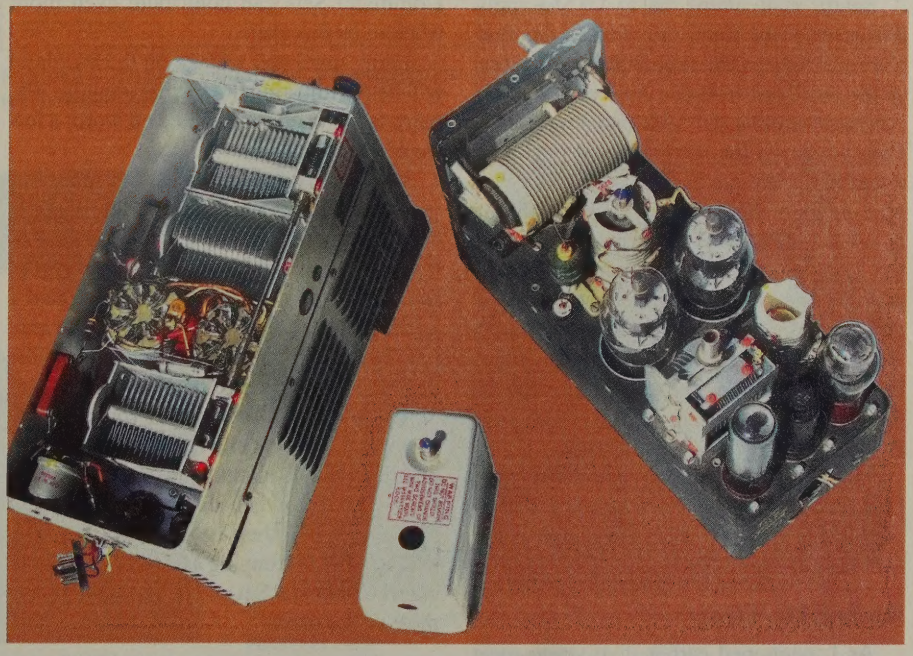
Back underneath, there are just a few more things to be done. Rewire the filaments to parallel if you're going to run from 12 V. If you do that, disconnect and consider removing R71, the big, black, wire-wound resistor mounted on the back wall under the 1629. It is also good to put a 0.01 μF disc ceramic bypass on the filament lead at the 1625 socket. If you want the 1629 circuit to operate properly and you're not running the filaments from 24 V dc, remove resistors R70 and R77 and replace R77 with a 2700 Ω, 1 W resistor.[4] Then make your power socket changes, if any, and that's about it for the basic conversion.

The BC459 Command Set transmitter.

You are now ready to go on the air. Hook up the power, the key, and a dummy load (a 60 W light bulb will be fine) for your first trial. Listen to the note on your receiver and adjust the link loading for a level that will give you an acceptable combination of output and keying. Watch the final plate or cathode current while you are doing this. You will probably wind up running somewhere between 70 and 120 mA. Now put your new rig on the air and have fun!

Pulling a BC-457 or BC-458 into the Band

In the good old days, a BC-696 or a BC-459 sold for 10 to 15 bucks or more

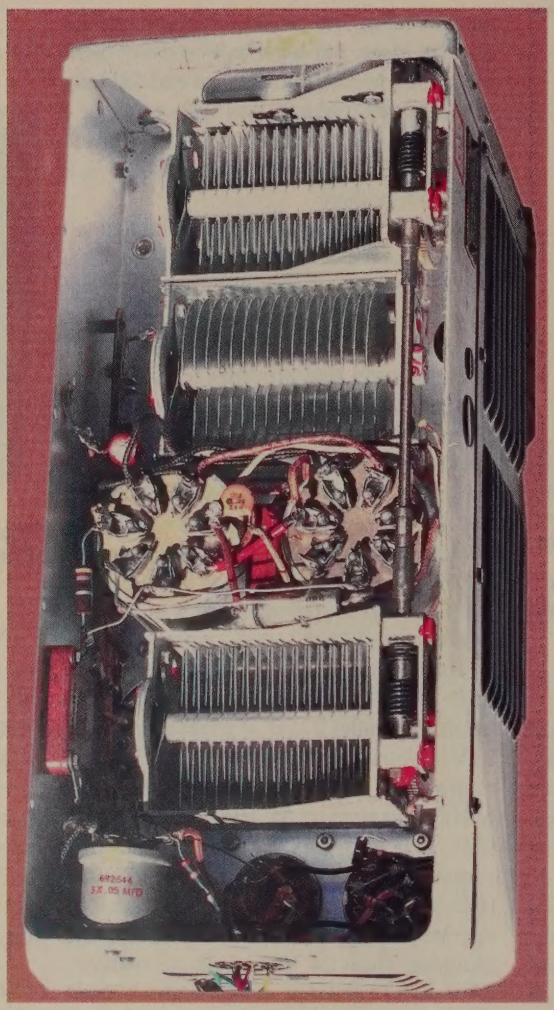


The BC459 and T-22/ARC5 transmitters side-by-side with the BC459 open and upside down displaying the capacitors and other components in the bottom of the rig, and with the T-22/ARC5 open and right side up displaying the top interior.

depending on condition, while a BC-457 or a BC-458 could be had for half that amount.[5] We soon found out how to retune the cheapies to 80 or 40. Let's start by putting a BC-457 into 80 meters.

You are going to adjust the trimmer capacitors on the oscillator and final to cover the new range. The oscillator trimmer is underneath the aluminum shield box on top of the chassis between the 1625s and the 1626 and 1629. Remove the shield and you'll see it. The trimmer shaft is held in place by setscrews in a collar around it, which is in turn secured by a screw fastening a lever attached to the collar to the trimmer frame. You might be able to get the setscrews loose if you have the right wrench and if that red Glyptol cement is willing. If not, just remove the screw holding the lever to the frame. Replace the shield and pop out the hole plug that gives you screwdriver access to the trimmer shaft. At no time should you mess with the settings of the slugs in the oscillator and amplifier coils. They adjust the tracking of the two tuned circuits and should be left alone.

The final amplifier trimmer is below decks, the second variable capacitor from the front and just behind the final tuning capacitor. It is secured the same way the oscillator trimmer is. Loosen it and pop out its tuning hole plug, and you're ready to retune the transmitter.



A view of the BC459 upside down with the bottom open.

Set the main tuning dial to 4.0 Mc, apply power to the oscillator only (not to the final plate or screen) and increase the capacitance of the oscillator trimmer until you hear the oscillator running at 3.5 Mc on your receiver. Then power up the amplifier and tune it to resonance with the oscillator, as indicated by a dip in the final plate or cathode current, by adjusting the amplifier trimmer. If possible, lock the trimmers in their new positions with the setscrews. If you couldn't get their collars loose, don't worry. The friction in the trimmers is quite adequate to keep them in place. Put back the hole plugs, replace the covers, and you are ready to run your BC-457 all over the 80 meter band.

Putting a BC-458 on 40 is the same process, except you set the frequency dial at 7.0 Mc and decrease the capacitance of the trimmers to hit 7.3 Mc.

Minimizing Chirp

As I mentioned earlier, I've yet to meet a BC-458 or BC-459 that didn't chirp. But there are things you can do to minimize it. Maybe some other vintage operators of Command Sets can contribute even more wisdom on this issue.

Using regulated voltage on the oscillator will help. Adjusting the final loading for less chirp is pretty effective and well worth a few watts' less output.

Another fix goes after the amplifier output signal that is fed back via the filament wiring into the oscillator. Put a low resistance choke, made from as many turns as you can wind of decent sized wire around a ferrite toroid, in series with the filament lead powering the 1625s. Bypass both ends of the choke to ground with 0.01 µF capacitors.

If you've done all this and you still have chirp, as I do, relax and enjoy it. You'll have one of the few, remaining distinctive signals on the air. And when some guy gives you a 579"c", he will then be amazed when you tell him you are running a 65 year old, World War II Command Set and he'll forgive you — most of the time.

Hints and Kinks

The crystal in the 1629 calibrator circuit connects to pins 1 and 3 of the center socket in the back. You can use any FT-243 crystal, for example one at the band edge, in this marker circuit.

The single-plate trimmer on top of the oscillator trimmer, accessed through the slide-open port on the top cover, is used to correct the dial calibration. It's conveniently used either with the internal calibrator crystal or with your receiver.

CQ Magazine published a great compendium of Command Set Transmitter and Receiver articles back in the '50s. Aptly titled *Command Sets*, it has a yellow, black and white cover with a picture of a black crackle finished transmitter. If you find one at a flea market, grab it. It is great reading and it will give you many more ideas.

Finally, you can find new tubes for your Command Set at **www.tubesandmore.com**.

A previous version of this article appeared in the July 1995 edition of Electric Radio *magazine.*

Notes

[1]W. Hutchens, KJ4KV, "Electric Radio in Uniform, 'Command' Sets — Part 1," *Electric Radio Magazine*, #11, Mar 1990.

[2]Also see J. Hanlon, W8KGI, "On the Air with the Command Set Triplets," *Electric Radio Magazine*, #74, Jun 1995.

[3]H. S. Brier, W9EGQ, "The Command Set Roundup," Command Sets, *CQ Technical Series*, 1957.

[4]This change comes from the *Surplus Radio Conversion Manual*, Volume 1, Second Edition, by R .C. Evenson and O. R. Beach, 1948, page 64. I haven't tried it myself, yet.

[5]My first BC-457 sold for $2.95, "as-is, removed from aircraft." It had many dents, three broken tubes and a shattered loading coil. After I pounded out the dents, washed out the salt and baked it dry, it worked just fine.

Jim Hanlon, W8KGI, is an ARRL member and was first licensed as WN4VIV in 1952. He earned his Bachelor's, Master's and Doctorate degrees in Electrical Engineering from The Ohio State University. Jim taught electrical engineering at Ohio State from 1964 through 1968, worked at Bell Laboratories for 25 years and at Sandia National Laboratory for 15 years before retiring in 2003. Jim is a vintage radio enthusiast and maintains a station consisting of 24 tube receivers and 38 tube transmitters. You can contact him at PO Box 581, Sandia Park, NM 87047; **w8kgi@arrl.net**. QST

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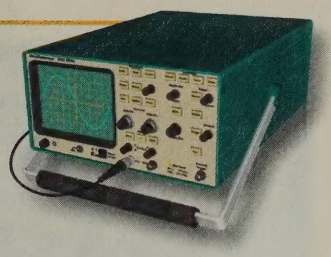
Bring That WWII Command Set Receiver Back to Life



Command sets were a big part of post WWII ham radio — it's not too late to join the fun!

Phil Salas, AD5X

The old US Army Air Forces ARC-5/BC-45X, and their US Navy equivalent series of receivers were used with matching transmitters in B-17 and B-24 bombers (typically two or three pairs) and P-38 fighters (one pair), as well as many other aircraft during WWII and Korea (see Figure 1). The BC-453 (190-550 kHz, the old *Q5er*), the BC-454 (3-6 MHz) and the BC-455 (6-9.1 MHz) receivers were very popular with hams in the 1950s and '60s, as they were readily available and inexpensive. Back in the '60s, I paid $5 for a brand new BC-455 receiver. It was surprisingly sensitive and stable, and I used it as my primary 40 meter receiver for a year or so. Unfortunately, I don't know what ever happened to that receiver. But I recently picked up one of these radios at a good price on one of the online auction sites. Once I received the BC-455, I began this modification and updating process, which turned into both a fun and nostalgic project.

Receiver Modifications

These receivers use six tubes with nominal 12.6 V filaments. The tubes are paired up so each pair's filaments are wired in series to operate from an aircraft's 26 V dc system. The receivers also need a 125 to 250 V dc high voltage source for the tube plate circuitry. The plate current requirement is less than 100 mA, while the filament requirement is 1.5 A. Other than a suitable power supply, these receivers are pretty much self-contained, so getting them up and running requires minimal effort. Basically, you need to figure out how to power it, replace the old paper and electrolytic capacitors, and add a BFO ON/OFF switch and VOLUME control.

My 13.8 V dc station power supply is used to power everything. I rewired the tube filaments in parallel so they could be directly powered from my supply. The plate supply is

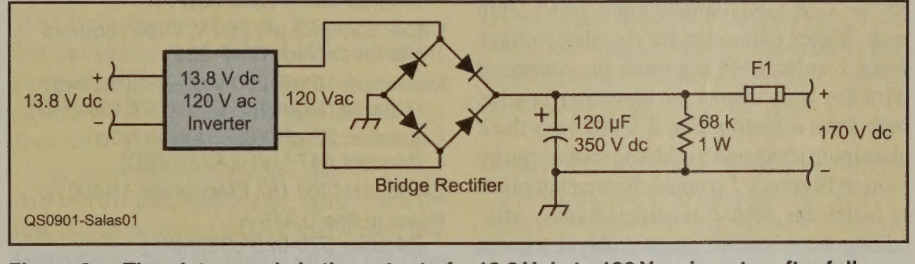


Figure 2 — The plate supply is the output of a 13.8 V dc to 120 V ac inverter after full wave rectification and filtering.

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Figure 1 — ARC-5 radios mounted in WWII vintage B-17 heavy bomber.

Figure 3 — LV and HV connectors on new connector plate at receiver rear.

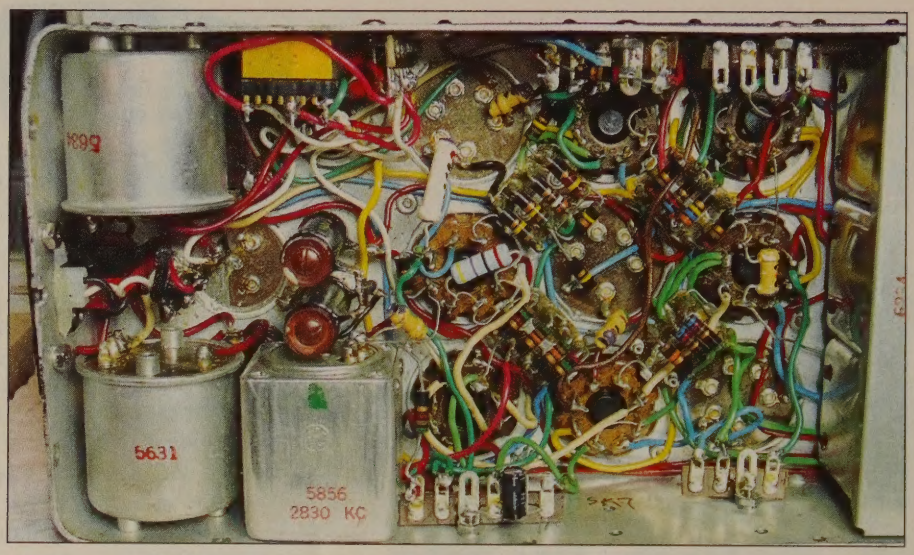

Figure 4 — Bottom view of receiver. Added on/off relay is at upper left.

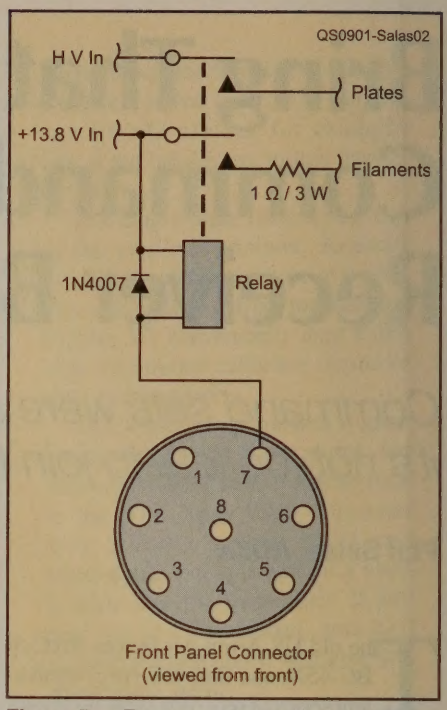

Figure 5 — Front panel connector wiring diagram.

the output of a 13.8 V dc to 120 V ac inverter after full wave rectification and filtering as shown in Figure 2. Any inexpensive inverter can be used to support the low plate current requirement. You can either build the rectifier circuitry directly into the inverter, or use an external rectifier assembly. Aside from being easy to build, this inverter also provides isolation from the ac line! More details can be found in a recent magazine article, or contact me at my e-mail address, below.[1]

I used an Anderson Powerpole connector for the 13.8 V dc filament input, and a 2-pin male Molex connector for the plate voltage input. I replaced the rear multi-pin connector with my own connector mounting bracket built from a small piece of 0.032 inch thick aluminum sheet and a nibbling tool as can be seen in Figure 3. I painted the bracket black to match the ARC-5 receiver chassis. After adding the dc connector assembly, I wired a 1 Ω, 3 W resistor in series with the 13.8 V input to drop the filament voltage to 12.3 V.

Next I replaced the three 0.22 µF, the twelve 0.05 µF and the three electrolytic (5 µF, 8 µF and 15 µF) capacitors with modern capacitors. After more than 50 years, these capacitors are almost certainly leaky, shorted or open. I used 10 µF electrolytics for both the 5 and 8 µF capacitors, and a 22 µF electrolytic for the 15 µF capacitor. Except for the 22 µF capacitor, all capacitors should be rated at 250 V dc or higher. The 22 µF capacitor can be rated at 100 V dc. The replacement capacitors are mounted on terminal strips. Figure 4 shows the main receiver bottom with all capacitors replaced.

Figures 5 and 6 show the front panel connector and component wiring diagrams. A 50 kΩ linear taper (*not* audio taper) potentiometer with integral SPST switch is used for the AUDIO GAIN and ON/OFF POWER control. The switch enables a small DPDT relay that turns on the receiver voltages. The switch connects to the relay by a new wire running

Table 1

Components Needed for ARC-5 Restoration

Bridge rectifier (All Electronics FWB-15).
Capacitor, 0.056 µF, 250 V, 12 required (Mouser 5989-250V.056-F).
Capacitor, 0.22 µF, 250 V, three required (All Electronics RMF-224).
Capacitor, 10 µF, 250 V electrolytic, two required (Mouser 647-UVR2E100MPD).
Capacitor, 22 µF, 100 V electrolytic (Mouser 647-UVR2A220MED).
Diode, 1N4007 (All Electronics 1N4007).
Fuse, in-line 0.375 A (Mouser 576-0251.375MXL).
Inverter, 13.8 V dc to 120 V ac (All Electronics INV-80, or equivalent).
Jack, ⅛ inch stereo (All Electronics MJW-20).
Pins, Molex 0.062, two required (Mouser 538-02-06-2103).
Plug, Molex 2-pin (Mouser 538-03-06-2024).
Potentiometer with switch, 50 kΩ (Mouser 31VM405-F).
Power connectors, Anderson Powerpole, two pair required (Powerwerx PP-RB-15-10).
Receptacle, Molex 2-pin (Mouser 538-03-06-101).
Relay, DPDT (Mouser 655-RTE24012F).
Resistor, 68 kΩ, 1 W (Mouser 594-5073NW-68K00J).
Sockets, Molex 0.062 inch, two required (Mouser 538-02-06-1103).
Switch, SPDT (All Electronics MTS-4).
Transformer, 8:1000 Ω (Mouser 42TL013-RC).

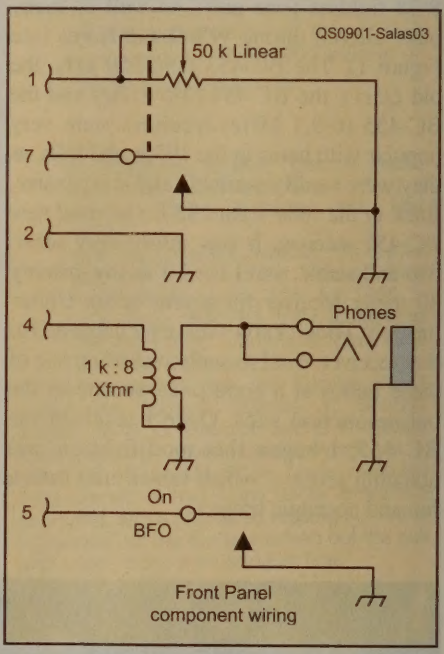

Figure 6 — Component wiring diagram.

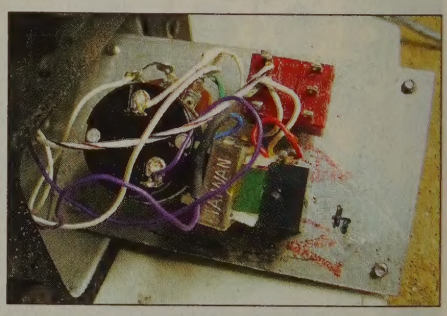

Figure 7 — Mounting of the switch, transformer and potentiometer on the front panel mounting plate.

[1]P. Salas, AD5X, "The Weekender," *CQ Magazine*, Jul 2007, pp 68-69.

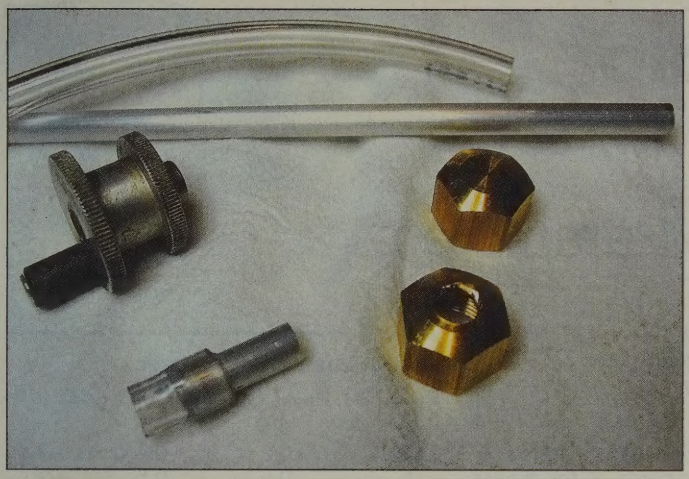

Figure 8 — Plastic tube, ¼ inch rod, ⅜ inch NPT cap and final shaft adapter/extension (lower left). At the upper left is the hard-to-find original knob.

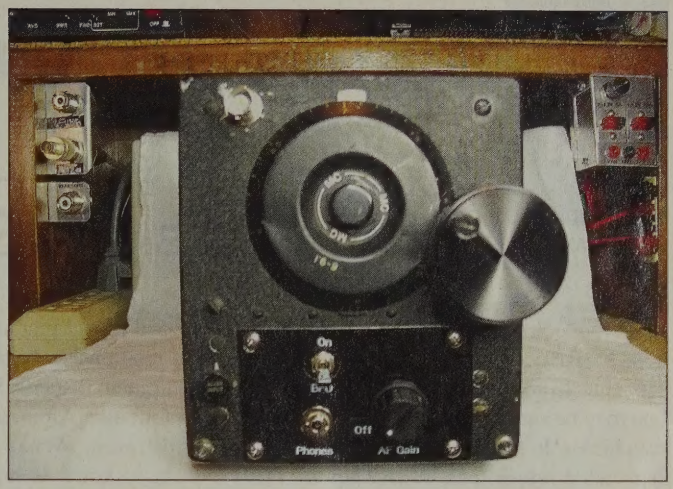

Figure 11 — Completed receiver front panel.

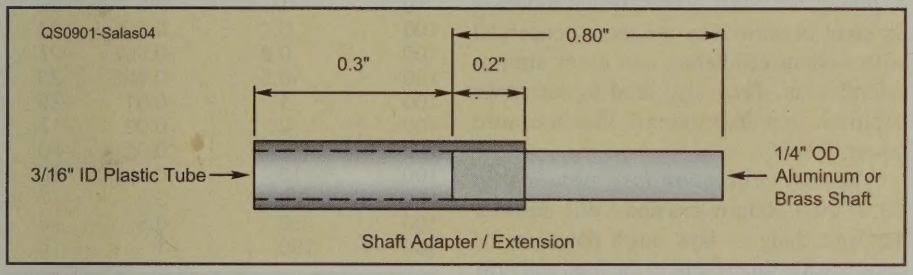

Figure 9 — New front panel tuning shaft extension.

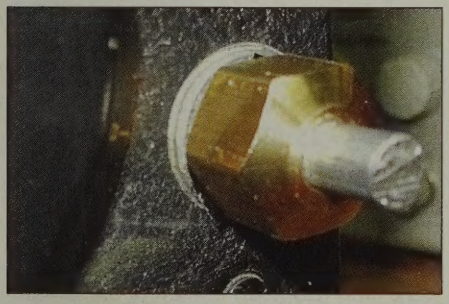

Figure 10 — Shaft adapter/extension in place.

from pin 7 of the original front panel connector. The relay plugs into a 16-pin IC socket and is then mounted upside down on the chassis with double-sided tape. A 1000:8 Ω audio transformer more closely matches the ARC-5 audio output to modern headphones. Figure 7 shows how I mounted the switch, transformer and pot on the front panel mounting plate.

Tuning Shaft

A final problem with these receivers is the recessed ¼ inch splined tuning shaft, which requires a special knob. These knobs are hard to find, and are expensive if you do find one. I built a very effective shaft adapter/extension that is easy to reproduce. All you need is a short piece of 3/16 inch ID plastic tubing, a ¼ inch OD aluminum rod, and a ⅜ inch NPT brass cap from your local hardware store. Figure 8 shows the individual shaft parts before assembly (top), the final shaft adapter, the drilled ⅜ inch NPT cap (bottom), and the hard-to-find ARC-5 tuning knob (left).

To make the shaft adapter, mix up a small dab of two part epoxy and lightly coat the first 0.2 inch of one end of the ¼ inch rod. Force the 3/16 inch ID plastic tubing over this end of the ¼ inch rod so it overlaps 0.2 inch of the aluminum rod. When the epoxy has cured, cut the tubing and aluminum rod as shown in Figure 9. Now align the open end of the plastic tube with the splined shaft and push the new shaft adapter into place. This takes a little effort at first, and then it almost snaps in place.

Put a knob on the shaft and verify that tuning works well. Next, pull the shaft adapter/extension off the radio and put just a *small* amount of epoxy into the open end of the plastic tubing with a toothpick. Then push the shaft adapter/extension back over the splined tuning shaft. To help support the shaft, I used a ⅜ inch NPT brass plumbing cap with a ¼ inch shaft clearance hole drilled in the center. As the ⅜ inch NPT brass cap is slightly larger than the ARC-5 shaft collar, wrap a few turns of black electrical tape over the shaft collar. Now you can screw the brass cap over the shaft adapter and the radio shaft collar. Figure 10 shows the new shaft adapter in place. The knob I used is an Eagle 1.75 inch diameter "spinner" tuning knob available from Mouser Electronics (part number 450-1755). Figure 11 shows the front of the completed receiver.

Conclusion

Rebuilding an ARC-5 receiver is one of the easier *boat anchor* restorations you can take on. Since so many of these receivers were built during WWII, they are still available at on-line auction sites for reasonable prices. When finished, you will wind up with a sensitive receiver that is both an interesting topic of discussion, as well as a nostalgic trip back to our youth (for some of us).

Photos by the author unless otherwise noted

Phil Salas, AD5X, is an ARRL Life Member, and was first licensed as a Novice in 1964. His Amateur Radio interests led him to a long engineering career in new product design and development of microwave and lightwave components and systems. Phil is now retired, and enjoys spending time with his wife Debbie, N5UPT, as well as tinkering with electronic projects.

You can reach Phil at 1517 Creekside Dr, Richardson, TX 75081 or at **dpsalas@tx.rr.com.**

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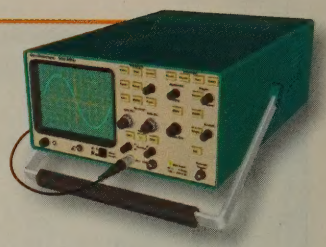
Talk Up Amateur Radio

N0AX

HANDS-ON RADIO



Experiment #72 — Return Loss and S-Parameters

If you look up the performance specifications for RF equipment, such as filters, in the literature from a commercial manufacturer, you may be surprised not to find SWR in the data tables. In its place, you'll find a parameter called *return loss*. What's up with that and how does it relate to SWR? That's the topic of this month's column and we'll also touch on *S-parameters*, not commonly used by hams but well-known in industry.

The Basics

Let's start with basic transmission line operation. If the load attached to a transmission line has the same impedance as the line's *characteristic impedance*, Z_0, all of the power flowing as electromagnetic waves toward the load in the line will be transferred to the load. If the load has some other impedance, higher or lower than Z_0, some of the power will be reflected back toward the power source (aka — the generator).

The forward wave (generator-to-load) and the reflected wave (load-to-generator) interfere with each other to create stationary patterns of voltage and current in the line called *standing waves*. The greater the difference in impedances between the line and the load, the larger the amplitude of the interference pattern will be.

If the pattern of voltages in the line is measured, the ratio of peak to minimum voltage is the *voltage standing wave ratio* or VSWR. The pattern's amplitude can also be measured as current to give ISWR, but voltage is more easily measured. VSWR and ISWR have the same value and are usually given the more general term, SWR.

Voltage and current in the transmission line are rarely measured directly outside the laboratory. Amateur SWR meters use directional coupler circuits to create voltages proportional to the power flowing in each direction and use a special meter scale to convert the ratio of the voltages to SWR. (Hands-On Radio Experiment #52 discusses how garden-variety SWR meters work.[1]) Wouldn't it be easier to just display forward and reflected power? Yes, but SWR is the mental model that amateurs use to describe the relationship between Z_L and Z_0, so our equipment displays SWR.

Outside Amateur Radio the situation is different. What RF engineers usually want to know is how much of the power in a transmission line will be delivered to a device or antenna and how much will be reflected. These engineers think in terms of power, not SWR. Their mental model is different because they are more concerned with system efficiency and other similar calculations. They also tend to use more sophisticated instruments that measure power directly.

Thus the term *return loss*, measured in dB, is used. Return loss and SWR measure the same thing — how much power in the transmission line is sent to the load and how much is reflected by it — but state the result differently.

Return loss (RL) =

$$10 \log_{10} (P_{REFL}/P_{FWD}) \text{ dB} \quad [1]$$

Because P_{REFL} is never greater than P_{FWD}, RL is always negative. The more negative RL, the less the amount of power reflected from the load compared to forward power. If all the power is transferred to the load because $Z_L = Z_0$, RL = $-\infty$ dB. If none of the power is transferred to the load, such as at an open or short circuit, RL = 0 dB. For practice, calculate RL for the following values of P_{FWD} and P_{REFL}:

(A) P_{FWD} = 100 W, P_{REFL} = 25 W
(B) P_{FWD} = 100 W, P_{REFL} = 1 W
(C) P_{FWD} = 1 kW, P_{REFL} = 50 W
(D) P_{FWD} = 5 W, P_{REFL} = 0.1 W

(Answers are provided at the end of the article.) Table 1 contains a series of values for P_{FWD} and P_{REFL} and the corresponding value of RL. Note that RL only depends on the ratio of power values, not the absolute values of the powers involved. RL is the same wherever P_{REFL} / P_{FWD} has the same value.

RL can also be calculated directly from power ratios, such as dBm (decibels with respect to 1 mW) or dBW (decibels with respect to 1 W). In this case, RL = P_{REFL} – P_{FWD} because the logarithm has already been taken in the conversion to dBm or dBW. (Ratios in dB are computed by subtraction, not division.) For example, if P_{FWD} = 10 dBm and P_{REFL} = 0.5 dBm, RL = 0.5 – 10 = –9.5 dB. Here are some more practice exercises:

(E) P_{FWD} = 25 dBm, P_{REFL} = 4 dBm
(F) P_{FWD} = 12 dBm, P_{REFL} = 6 dBm
(G) P_{FWD} = 10 dBW, P_{REFL} = 1 dBW
(H) P_{FWD} = 1 dBW, P_{REFL} = –20 dBW

Both power measurements must have the same units (dBm, dBW, etc) for the subtraction to yield the correct results. For example, one can't subtract dBW from dBm directly. Bonus exercise — what if P_{FWD} is 10 dBW and P_{REFL} is 20 dBm? (1 W = 1000 × 1 mW, so to convert dBW to dBm, add $\log_{10}(1000)$ = 30 dB. The answer to the bonus exercise is then 20 dBm – 40 dBm = –20 dB.)

As you can see, the more negative the value of RL, the smaller the fraction of forward power that is reflected towards the source. More negative values of RL are "better" in the same sense that lower values of SWR are "better."

Table 1
Return Loss Versus Power

P_{FWD} (W)	P_{REFL} (W)	P_{REFL}/P_{FWD}	RL (dB)
1	0.1	0.1	–10
1	0.2	0.2	–7
1	0.5	0.5	–3
1	1	1	0
10	0.1	0.01	–20
10	0.2	0.02	–17
10	0.5	0.05	–13
10	1	0.1	–10
100	0.1	0.001	–30
100	0.2	0.002	–27
100	0.5	0.005	–23
100	1	0.01	–20
100	2	0.02	–17
100	5	0.05	–13
100	10	0.1	–10
100	20	0.2	–7
100	50	0.5	–3
100	100	1	0

SWR to Return Loss Conversion

If SWR and RL measure the same thing — reflected power as a fraction of forward power — can one be converted to the other? Of course. There are tables of those conversions, but how about an equation instead?

Start by converting RL back to a power ratio as follows:

[1]Previous Hands-On Radio columns are available to ARRL members at **www.arrl.org/tis/info/HTML/Hands-On-Radio**.

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12SK7 - I.F.	6SK7
12SR7 - 2nd Det.	6SQ7, 6SR7
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In these instructions you'll find only the data needed to construct a power supply, add a gain control, BFO-switch and provisions for a speaker or headphones. Many articles have been written on adding AVC, an additional audio circuit and other refinements to these receivers. Below are references for those who may wish to further modify these receivers. The SCR-274N Receivers are identical except for frequency coverage, and the following will apply to all.

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Most of the used receivers available on the surplus market are complete with dynamotor for 24-volt operation. The dynamotor has little use in most ham shacks, but don't discard the dynamotor mounting base. There's plenty of space on one for constructing a complete AC Power Supply. By using a standard 50 ma. replacement power transformer and connecting the 5 and 6.3 volt windings in series you have sufficient filament voltage for the 12-volt tubes. This requires paralleling the filaments but the job is easy and you have no future replacement problem.

NOTE: - When connecting the 5 and 6.3 volt windings in series be sure they add; otherwise the resulting voltage will be the difference (1.3 volts).

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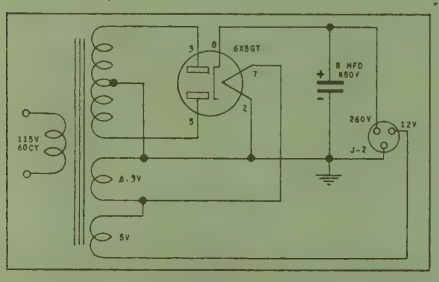

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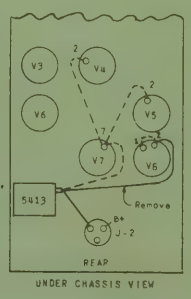

Fig. 2

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All SCR-274N receivers are wired for 24V filament operation. To parallel the filaments for 6 or 12V operation, remove white wire from pin #2 of V8 and connect to pin 7 of V7. This white wire runs from condenser 5413 to V8. Connect pin 2 of V8 to pin 1 (Ground). Run new leads from pin 7 of V7 to pin 2 of V5 and to pin 2 of V4. This puts all tube filaments in parallel. See Fig. 2

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For local tuning a spline and standard 1/4" shaft knob can be used, or the cable connector can be removed from the front panel and a knurled shaft type knob with extension shank used. For remote tuning use a flexible shaft and remote control box or suitable type of crank.

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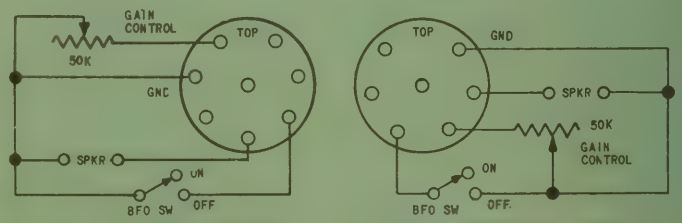

FRONT PANEL CONNECTIONS - OUTSIDE VIEW REAR SOCKET CONNECTIONS - OUTSIDE VIEW

Fig. 3

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If the speaker being used does not have a transformer to match the output impedance, it will be best to remove the output transformer in the receiver and replace it with a suitable transformer.

Speaker or headphone connections can be soldered to the rear socket, or pin-jacks installed in front or rear panel.

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Srepco 2-25-49

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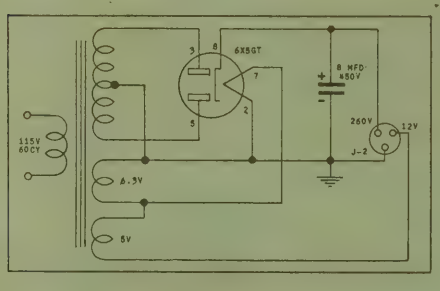

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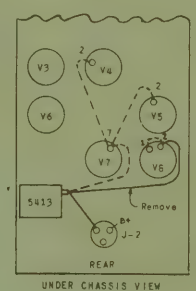

UNDER CHASSIS VIEW

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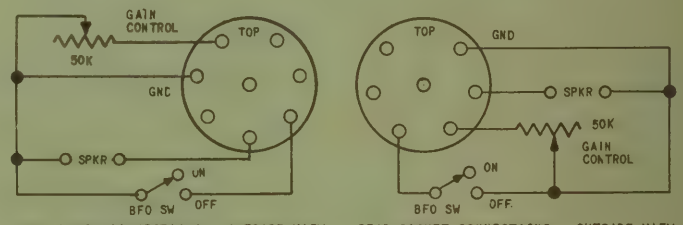

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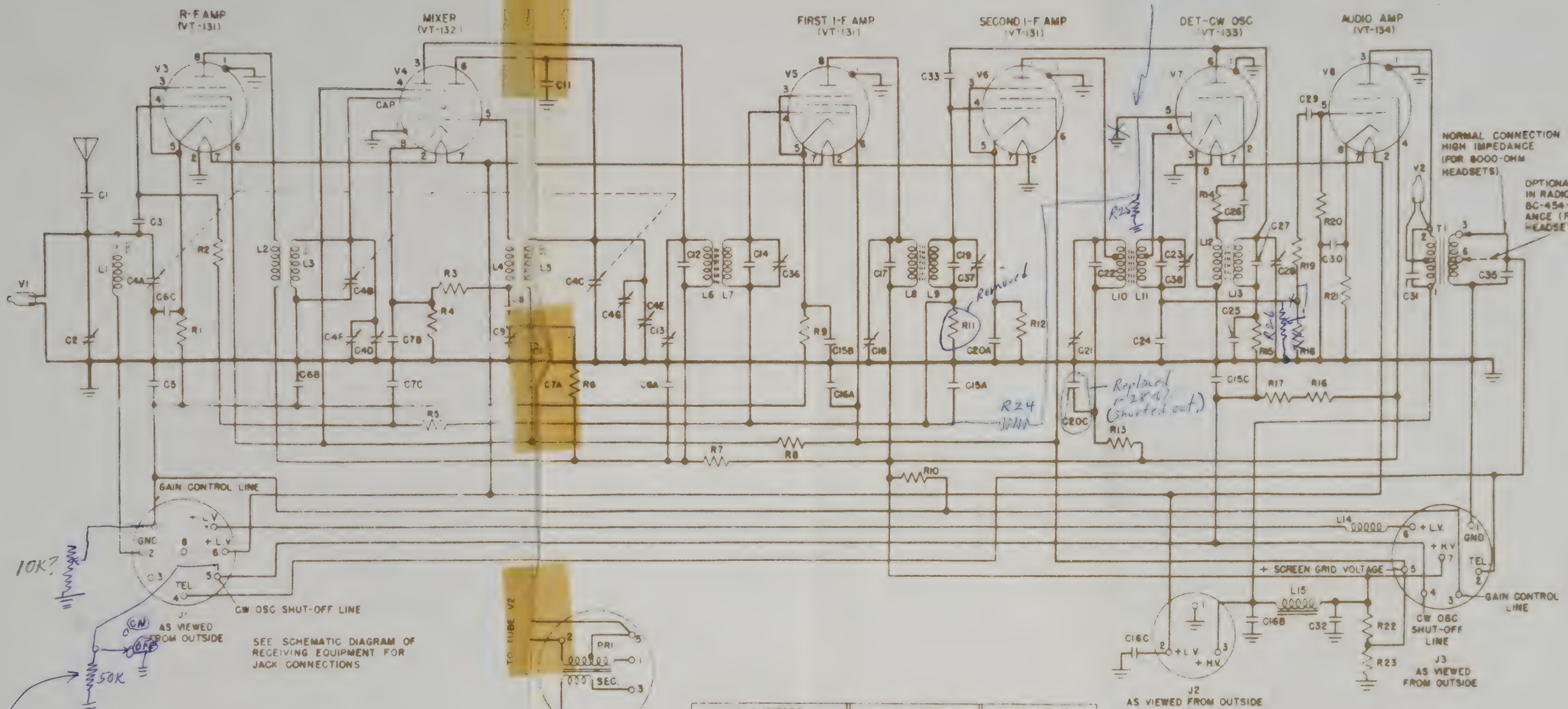
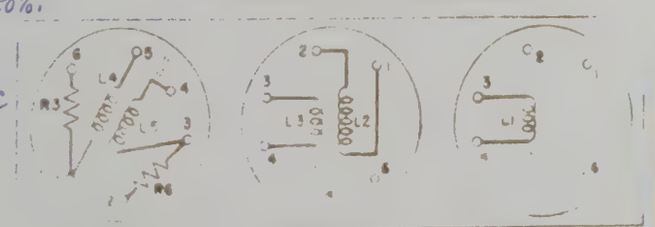
Srepco 2-25-49

AVC added 1-29-67

Filaments changed to 12V – 1966

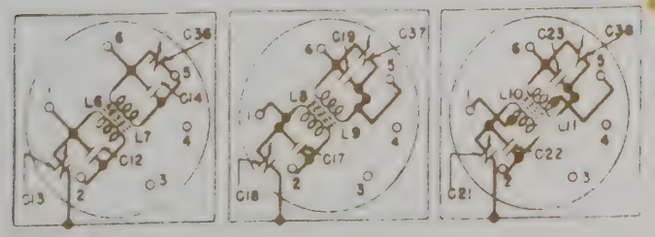


DETAIL SCHEMATIC DIAGRAMS
COIL ASSEMBLIES AND TRANSFORMERS



SYMBOL Z5C — R-F OSC. ANT.
SYMBOL Z5B — R-F AMP.
SYMBOL Z5A — R-F ANTENNA

R-F COIL UNIT (3-6 MC) SYMBOL Z5

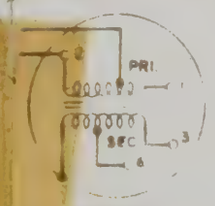


SYMBOL Z1 — 1ST I-F — 1415 KC
SYMBOL Z2 — 2ND I-F — 1415 KC
SYMBOL Z3 — 3RD I-F — 1415 KC

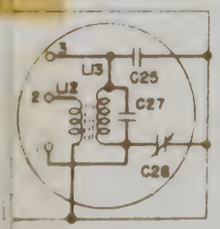
I-F COUPLING UNITS

CIRCUITS IN R COIL SET, I-F COUPLING UNITS, C W OSCILLATOR, AND OUTPUT TRANSFORMER. THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE PRACTICAL WIRING DIAGRAM

SYMBOL T1
OUTPUT TRANSFORMER
RADIO RECEIVER BC-454-A



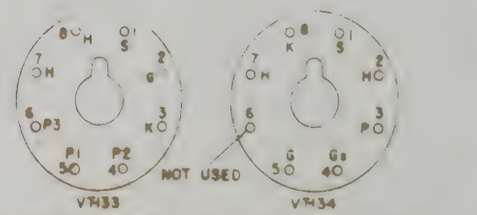
SYMBOL T1
OUTPUT TRANSFORMER
RADIO RECEIVER BC-454-B



SYMBOL Z4
C W OSCILLATOR
1415 KC

CAPACITORS		INDUCTORS		RESISTORS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C1	11 MMF	L1	ANT. INPUT	R1	620
C2	15 MMF	L2, L3	RF AMP	R2	2,000,000
C3	100 MMF	L4, L5	RF OSC	R3	51,000
C4 (A TO G)	GANG 1147 MMF)	L6, L7	IN IST IF	R4	620
C5	3 MF	L8, L9	IN 2ND IF	R5	150,000
C6 (A,B,C)	.05/.05/.05 MF	L10, L11	IN 3RD IF	R6	200,000
C7 (A,B,C)	.05/.05/.05 MF	L12, L13	CW OSC.	R7	200
C8	200 MMF	L14	RF CHOKE, 112 MICRO-HENRIES	R8	200
C9	40 MMF			R9	620
C10	365 MMF	L15	AF CHOKE 3 HENRIES	R10	380,000
C11	3 MMF			R11	100,000 — Removed.
C12	180 MMF			R12	540
C13	17 MMF			R13	200
C14	180 MMF			R14	100,000
C15 (A,B,C)	.05/.05/.05 MF			R15	5100
C16 (A,B,C)	22/22/22 MF			R16	51,000
C17	180 MMF			R17	51,000
C18	17 MMF			R18	510,000 — Removed
C19	180 MMF			R19	100,000
C20 (A,B,C)	.05/.01/.05 MF			R20	2,000,000
C21	17 MMF			R21	1500
C22	180 MMF			R22	7000
C23	180 MMF			R23	7000
C24	200 MMF			R24	~~27,000~~ 1M ±2
C25	.001 MF			R25	1M
C26	100 MMF			R26	1M
C27	180 MMF				
C28	34 MMF				
C29	.006 MF				
C30	15 MF				
C31	.001 MF				
C32	5 MF				
C33	*				
C35	750 MMF				
C36	17 MMF				
C37	17 MMF				
C38	17 MMF				

* WIRING CAPACITANCE (LESS THAN 2 MMF.).



TUBE SOCKET TERMINALS AS VIEWED FROM BOTTOM

G = CONTROL GRID
G (HEX) = CONTROL GRID, HEXODE SECTION
G (OSC) = CONTROL GRID, OSC SECTION
Gs = SCREEN GRID
Gs (HEX) = SCREEN GRID, HEXODE SECTION
H = HEATER
K = CATHODE
P = PLATE
P (HEX) = PLATE, HEXODE SECTION
P (OSC) = PLATE, OSC SECTION
P1 = FIRST DIODE PLATE
P2 = SECOND DIODE PLATE
P3 = TRIODE PLATE ON TUBE VT-133
S = SHELL
Su = SUPPRESSOR GRID

RADIO RECEIVER BC-454-A (OR -B) (3-6 MC) SCHEMATIC

BC-454 — Showing modifications

In an earlier article on using the BC-454, a hint was dropped that there was a simple way of getting higher i.f. selectivity in these popular receivers. This is it. As old as the single-signal receiving concept, it's close to being a no-cost method of getting high selectivity.

Improving the Selectivity of the BC-454 or 455

BY LEWIS G. McCOY,* W1ICP

A Poor Man's *Q* Multiplier

THE BC-454 is very popular both as an 80-meter receiver and as a tunable i.f. in a multiband receiving arrangement, as the response to recent articles [1] in *QST* has proved. Those interested in getting a lot of selectivity, with minimum cost and effort, from the 454 will find the "poor man's *Q* multiplier" described in this article a very simple way to do it.

The circuit, with "before" and "after" details, is shown in Fig. 1. All that is required is the addition of a 5000-ohm variable resistor, R_1, and a capacitor, C_1. The circuit change consists of lifting the cathode resistor of the 12SK7 second-i.f. tube from chassis ground and inserting the 5000-ohm resistor as shown. C_1 is made from two short lengths of insulated wire. One piece is connected to the grid terminal on the tube socket and the other to the plate terminal. The other ends of the wires are left open; thus the two wires serve as a coupling capacitor between the grid and plate circuits of the second i.f. stage. When the 5000-ohm resistor is varied the i.f. stage can be made to oscillate. At the point just below oscillation the over-all selectivity of the receiver is considerably improved. In fact, the selectivity approaches that obtained with much more elaborate circuitry.

* Technical Assistant, *QST*.

[1] McCoy, "Getting Started with the BC-454," *QST*, January, 1959.

McCoy, "80 Through 6 with the BC-454," *QST*, May, 1959.

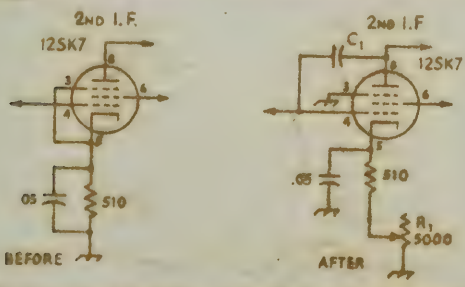


Fig. 1—Circuit diagrams before and after modification of the second i.f. stage.

C_1—See text.
R_1—5000-ohm potentiometer.

How To Do It

Fig. 2, a bottom-view layout drawing of the receiver, will help in identifying the proper tube socket. After taking off the bottom plate, remove the two screws that hold the potted capacitor directly over the second i.f. tube socket. It isn't necessary to unsolder the lead to the capacitor; there is enough lead length so the capacitor can be laid to one side, leaving plenty of room to work at the socket.

Remove the jumper wire between Pins 3 and 5 and ground Pin 3 to the nearest chassis ground connection. Locate the cathode resistor, which is on the mounting board immediately to the rear of the tube socket. The resistor, 510 ohms (green-brown-brown), should be the first unit, nearest the tube socket. One side of the resistor is connected to the cathode terminal, Pin 5, and the other side goes to chassis ground. Unsolder the end of the resistor connected to ground. The simplest method of doing this is to hold the lead with long-nose pliers and heat the connection, then when the solder melts pull up gently on the lead and it will come out of the terminal.

If you have your receiver mounted on a separate chassis as described in the January, 1959, *QST* article, the 5000-ohm resistor can be installed on the chassis. If not, a small right-angle bracket can be mounted on the side of the receiver case to hold it. Once you decide on the mounting, all you need do to complete the installation is connect a lead from the ungrounded end of the 510-ohm resistor to the movable arm of R_1 and connect one fixed terminal of R_1 to chassis ground.

The feedback capacitor, C_1, consists of two pieces of insulated wire (any convenient gauge) approximately ¼ inch long. Solder one wire to Pin 4 and the other to Pin 3. Position the two so they are parallel to each other and about ⅛ inch apart. Make sure the free ends of the wires aren't touching anything.

Adjustments

Use a clip lead to connect the case of the potted capacitor to chassis ground temporarily.

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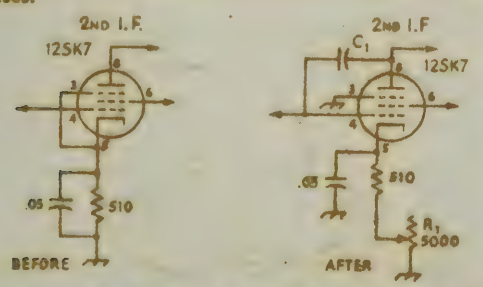

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Remove the jumper wire between Pins 3 and 5 and ground Pin 3 to the nearest chassis ground connection. Locate the cathode resistor, which is on the mounting board immediately to the rear of the tube socket. The resistor, 510 ohms (green-brown-brown), should be the first unit, nearest the tube socket. One side of the resistor is connected to the cathode terminal, Pin 5, and the other side goes to chassis ground. Unsolder the end of the resistor connected to ground. The simplest method of doing this is to hold the lead with long-nose pliers and heat the connection, then when the solder melts pull up gently on the lead and it will come out of the terminal.

If you have your receiver mounted on a separate chassis as described in the January, 1959, *QST* article, the 5000-ohm resistor can be installed on the chassis. If not, a small right-angle bracket can be mounted on the side of the receiver case to hold it. Once you decide on the mounting, all you need do to complete the installation is connect a lead from the ungrounded end of the 510-ohm resistor to the movable arm of R_1 and connect one fixed terminal of R_1 to chassis ground.

The feedback capacitor, C_1, consists of two pieces of insulated wire (any convenient gauge) approximately ¾ inch long. Solder one wire to Pin 4 and the other to Pin 8. Position the two so they are parallel to each other and about ⅛ inch apart. Make sure the free ends of the wires aren't touching anything.

Adjustments

Use a clip lead to connect the case of the potted capacitor to chassis ground temporarily.

The feedback capacitor, C_1, may require adjustment and it is easier to do with the capacitor out of the way.

Apply power to the receiver and let it warm up. Set R_1 so all the resistance is in the circuit. Next, adjust the b.f.o. trimmer so that the background noise has a high pitch. The trimmer control is the small screw in the square box mounted on one side of the receiver near the rear, and is accessible from the side of the case. Only a slight adjustment of the screw should be required.

Next, tune in a c.w. signal. Slowly decrease the resistance of R_1 and you should find a setting where the i.f. stage will go into oscillation. This will be indicated by a howl. Set the control just below the point of oscillation and tune the receiver across the signal. You should find a tuning dial setting where the signal peaks quite sharply. In addition, as you tune through the signal from one side of zero beat to the other, you'll notice that the beat note on one side is much weaker than on the other.

If you find that you cannot get the conditions just described or that the i.f. cannot be made to oscillate regardless of the setting of the resistor, try moving the wires forming C_1 closer together. Once you get the correct setting you can remount the potted capacitor, making sure the open ends of C_1 aren't shorting to the capacitor case.

The modifications described here were tried on both the BC-454 and 455 with equally good results. For the very small expense and labor — the modification only takes about an hour and a half — it is pretty hard to find a better method of improving the performance of these popular receivers.

One final tip: Keep the receiver gain down so the signals arriving at the second i.f. stage aren't too strong. The regeneration in this stage will build them up to normal strength. The more you depend on the regeneration for gain the better the selectivity. QST

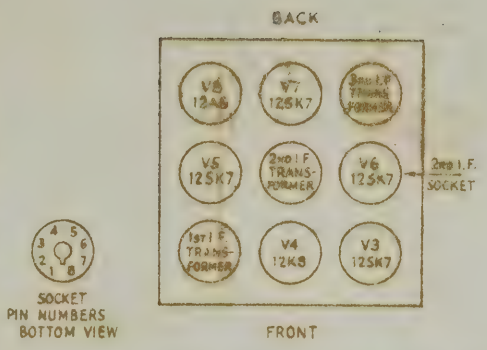


Fig. 2—Layout diagram (bottom view) of the receiver showing locations of tube sockets and i.f. transformers.

Strays

We're told about one ham who has an "interesting" way of switching his high voltage on and off. Because all the current flows through a volt-ohmmeter, he turns his carrier on and off merely by plugging and unplugging a test lead from the v.o.m. FB, OM! This is the sort of thing that sets a *fine* example for beginners.

— • • • —

Anyone want to listen to the amplifier described on page 37 of the December issue of *QST*? Watch for W3EFZ, who has been using it to keep 14/21/28 Mc. c.w. hot.

A Reminder

On the average, man is a 0.25-megohm, 1-watt resistor.
At 1 milliampere, shock is perceptible.
At 10 ma., you can't let go.
100 ma. is generally fatal.
and technicians are already in short supply.

Don't make an ash of yourself!

— • • • —

Ham shack cold? W6WFR suggests replacing your desk light with a 150- or 250-watt heat lamp — keeps you warm as toast and gives you light too.

Turning Boy Scouts into hams is one of the latest projects of California amateurs. The Aircraft Electrical Society, in an effort to spur interest in science, has purchased a Gonset III for each of the 13 Explorer (high school age Boy Scouts) posts in Los Angeles. The Society has also equipped a house trailer with a modern weather station, high-powered telescope for astronomy projects, a complete radio station and an electronics laboratory and books.

Ray Meyers, W6MLZ, ARRL Southwestern Division director, left, stands by the trailer with Luther Monell, W6QGV, who is coordinating Scout activities in the amateur radio field. W6QGV is organizing a 2-meter Explorer Net. W6MLZ has sent out a call to Los Angeles area hams to act as Explorer Post advisors, teaching the boys code and theory. The AES says it will expand the project if results are good in Los Angeles.

INSTRUCTIONS FOR CONVERTING SCR-274N RECEIVERS

FACTUAL DATA ON THE SCR-274N RECEIVERS

Model	Freq. Coverage	I.F. Freq.
BC-453	190 - 550 K.C.	85 K.C.
BC-946	520 - 1500 K.C.	239 K.C.
BC-454	3 - 6 Mc.	1415 K.C.
BC-455	6 - 9.1 Mc.	2830 K.C.

Tube Complement	6 Volt Equivalent
12SK7 - R.F.	6SK7
12K8 - Mixer	6K8
12SK7 - I.F.	6SK7
12SK7 - I.F.	6SK7
12SR7 - 2nd Det.	6SQ7, 6SR7
12A6 - Audio	6K6, 6V6, 6F6

Plate Requirements: 200 - 250 Volts at 40 MA

Filament Requirements: 24 Volts at .45 amps
or 12 Volts at .9 amps

Output: A-series receivers 6000 ohms.
B-series receivers 600 or 6000 ohms.

In these instructions you'll find only the data needed to construct a power supply, add a gain control, BFO-switch and provisions for a speaker or headphones. Many articles have been written on adding AVC, an additional audio circuit and other refinements to these receivers. Below are references for those who may wish to further modify these receivers. The SCR-274N Receivers are identical except for frequency coverage, and the following will apply to all.

AC POWER SUPPLY

Most of the used receivers available on the surplus market are complete with dynamotor for 24-volt operation. The dynamotor has little use in most ham shacks, but don't discard the dynamotor mounting base. There's plenty of space on one for constructing a complete AC Power Supply. By using a standard 50 ma. replacement power transformer and connecting the 5 and 6.3 volt windings in series you have sufficient filament voltage for the 12-volt tubes. This requires paralleling the filaments but the job is easy and you have no future replacement problem.

NOTE: - When connecting the 5 and 6.3 volt windings in series be sure they add; otherwise the resulting voltage will be the difference (1.3 volts).

The power transformer is mounted 1/4" above the base, using two 1/2" x 3/4" angle brackets attached to side of transformer opposite the leads. The lead side is mounted out and the leads are dressed under the transformer to the socket and other terminals.

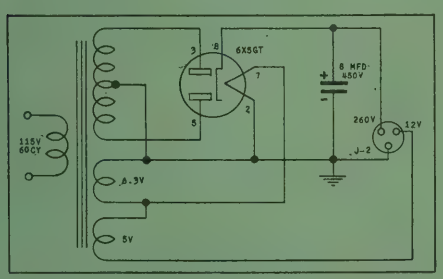
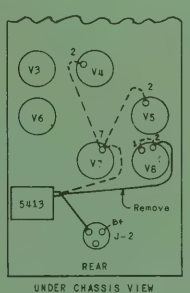


Fig. 1



UNDER CHASSIS VIEW

Fig. 2

TO PARALLEL RECEIVER FILAMENTS

All SCR-274N receivers are wired for 24V filament operation. To parallel the filaments for 6 or 12V operation, remove white wire from pin #2 of V8 and connect to pin 7 of V7. This white wire runs from condenser 5413 to V8. Connect pin 2 of V8 to pin 1 (Ground). Run new leads from pin 7 of V7 to pin 2 of V5 and to pin 2 of V4. This puts all tube filaments in parallel. See Fig. 2

TUNING

For local tuning a spline and standard 1/4" shaft knob can be used, or the cable connector can be removed from the front panel and a knurled shaft type knob with extension shank used. For remote tuning use a flexible shaft and remote control box or suitable type of crank.

GAIN CONTROL AND BFO SWITCH

Remove plug-in box from front of receiver and save only the small panel and mounting screws. Install gain control and BFO switch on this small panel; make connections in accordance with Fig. 3 by soldering directly to the small banana plugs.

For a neat installation the gain control can be placed in the center of the small panel and the BFO switch installed on right side of the receiver front panel directly opposite "Align Input" condenser. To provide room for switch, remove the 3 mfd condenser (C-5) and its associated wire. This condenser is not required except in aircraft installations.

Alternate Connections for Gain Control BFO Switch and Speaker

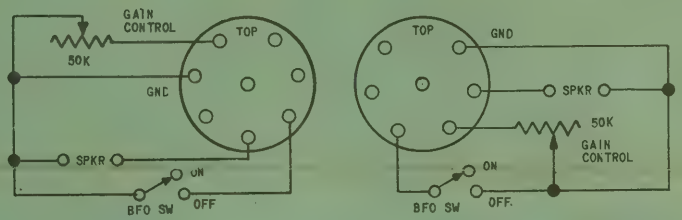


Fig. 3

SPEAKER AND HEADPHONE PROVISIONS

The output of these receivers is sufficient for small speakers. Where the BFO is not required, the triode section of the 12SR7 can be used as a first audio stage to increase the audio power.

If the speaker being used does not have a transformer to match the output impedance, it will be best to remove the output transformer in the receiver and replace it with a suitable transformer.

Speaker or headphone connections can be soldered to the rear socket, or pin-jacks installed in front or rear panel.

SCR-274N CONVERSION REFERENCES

RECEIVERS

Converting the SCR-274N Receivers	CQ Nov 47
The Lazy Man's Q5-er (BC-453)	QST Jan 48
BC-946 Broadcast Receiver	RC Feb 48
Conversion of the SCR-274N Rcvrs	RN Jun 48
Q5-er for BC-348 Owners	QST Jun 48
Putting the BC-455 on 10	CQ Sep 48
Bandspreading the BC-455	CQ Nov 48
More Selectivity for the BC-455	RC Dec 48

TRANSMITTERS

Converting the SCR-274N (BC-457)	CQ May 46
10-Meter Mobile with the SCR-274N	CQ Jan 48
Conversion Notes on the BC-696-A	RN Mar 48
BC-459 - 40 and 20-meter Operation	CQ Mar 48
ARC-5 Transmitter Modifications	QST Jun 48
Variations in the Modification of the SCR-274N Transmitters	CQ Jul 48
Bandspreading the SCR-274N	CQ Aug 48
VFO from Surplus (BC-458)	RC Jan 49

RC - Radio Craft RN - Radio News

The Surplus Radio Conversion Manuals published by Editors and Engineers contain a wealth of information, most of it not available from magazine articles.

Volume #1 – Has 12 pages devoted to converting the SCR-274N Receivers for mobile use, 10 meters, and the BC-453 as a Q5'er. Also BC-221, 312, 342, 348, 412, 645, 1068, SCR-274N TX, SCR-522, TBY, PE-103, plus surplus index, VT Tube chart. **$2.60 postpaid**

Volume #2 – Has 18 pages devoted to converting the SCR-274N Receivers and Transmitters to 10 meters. Also BC-357, 375, APS-13, ART-13, ARC-5 VHF RX/TX, AM-26, GO-9/TBW, TA-12B, LM Freq. Meter, ARB Diagram only, Selenium Rectifier Circuits, and Surplus Beam Rotating Mechanisms. **$2.60 postpaid**

SREPCO 2-25-49

MODIFICATIONS OF BC-454

A. Addition of more effective automatic volume control:

1. Remove R11.
2. Break the connection between pin 5 of 12SR7 and ground.
3. Connect a 1M-ohm ½-watt resistor from pin 5 of 12SR7 to ground.
4. Connect a 1M-ohm ½-watt resistor from pin 5 of 12SR7 to hot side of C15A. (This was just an easy spot to reach. This resistor can be inserted between 12SR7 and the hot side of the mounting where R11 was removed.)

This modification is shown in a Verifax copy I have from somebody's book on these receivers.

B. Addition of audio gain control.

1. Remove R18.
2. Unsolder and lift up the end of R19 that was connected to R18.
3. Cut a convenient length of 3-conductor cable (or 3 individual wires) and connect as follows:
   (Say the wires are black, white, and red)
   a. Black wire to grounded terminal where R18 was.
   b. Red wire to hot terminal where R18 was.
   c. White wire to free end of R19.
4. With the receiver upside down and the dial toward you, lead cable (or wires) to the right, between the mounting lugs of a couple of the condensers mounted there, and to the back of the receiver along the side of the chassis. This may be an unnecessary precaution, but it keeps the leads away from the audio wiring in the center rear of the receiver and reduces the possibility of feedback.
5. Install a 500,000-1,000,000 ohm potentiometer wherever convenient and connect the other end of the 3-conductor cable (or 3 wires) as follows:
   a. Black wire to cold end.
   b. Red wire to hot end.
   c. White wire to wiper-arm terminal.
6. File a small notch in the back of the receiver chassis for the wires to go through.

The potentiometer replaces R18, which is 510,000 ohms. I couldn't find a 500,000-ohm pot, though, so I used a 1-megohm pot and it works fine. My leads from the receiver to the potentiometer are nearly 3 feet long and I have had no trouble with feedback.

C. Modification for use of BFO with AVC.

When the AVC is installed as described, the BFO works on it and reduces the gain of the receiver tremendously. To correct this, install a 50,000-ohm resistor across the terminals of the BFO on-off switch. This reduces the BFO injection about 50%, but it is still adequate. The effect of the BFO on the gain is still noticeable, but the receiver would still be OK for all but the weakest signals.

A4PRD/2-15-67

Copies to AD4BXZ and A4THO 2-15-67

CONVERTING THE SCR-274N COMMAND SET RECEIVERS (BC-453 Series)

"Q-5'er" CONVERSION — 10-METER CONVERSION

Introduction:

The SCR-274N series of command-set receivers includes the BC-453, BC-454, and the BC-455. Almost identical counterparts to these three are available in the ARC-5 command-set series.

The BC-453 (and its ARC-5 equivalent) is quite effective and justifiably popular as a "sharp-channel" i-f system to follow a conventional communications receiver. Either the BC-454 or the BC-455 may be used intact as a communications receiver, but it will be found that the receivers are excessively broad in selectivity due to the high value of intermediate frequency which is employed. However, due to this relatively high i.f. either of the latter types of receiver may be converted for image-free operation on the 10-meter band by revamping the r-f coil assembly and the main tuning capacitor. In addition, several changes are required in the audio circuit. These changes are similar to those suggested previously for the BC-946B conversion.

(a) General Description:

The command-set receivers, designed for aircraft use, are light, very compact, and totally shielded in an aluminum case. Each is a 6-tube superheterodyne with one r-f stage, two i-f stages, mixer, detector, beat oscillator and audio. All are designed to operate from a 28-volt d-c source, with a dynamotor supplying the plate voltage.

The units of this series are substantially identical with the exception of the main tuning capacitor, and the r-f and i-f coils which are plug-in units. Frequency coverages and intermediate frequencies are as follows:

Unit	Frequency Coverage	Intermediate Frequency
BC-453	190 to 550 kc.	85 kc.
BC-454	3 to 6 Mc.	1415 kc.
BC-455	6 to 9.1 Mc.	2830 kc.

(b) Ten-Meter Conversion--Modifying the R-F Coil Assembly:

This modification involves rewinding of the coils in the plug-in coil assembly to obtain coverage of the 28-Mc. band. Modification of the tuning capacitors to obtain bandspread operation is discussed in a later paragraph.

L 1 (Ant. coil) - Remove the existing winding and rewind with 6 turns of #18 enameled wire, space wound the full length of the coil form.

L 2 (RF mixer coil) - Remove the existing "honey-comb" coil with the exception of the last layer. This will leave approximately 9 turns for L 2.

CONVERTING THE SCR-274N COMMAND SET RECEIVERS
(BC-453 Series)

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L 2 (RF mixer coil) - Remove the existing "honey-comb" coil with the exception of the last layer. This will leave approximately 9 turns for L 2.

L 3 (RF mixer coil) - Remove the existing winding and rewind with 5 turns of #18 enameled wire, spacing the winding evenly the full length of the coil form.
L 4 (Osc. coil) - No alteration is necessary on this coil.
L 5 (Osc. coil) - Remove the existing winding and rewind with 5 turns of #18 enameled wire, close spaced. L 5 should be between 1/8 and 3/16 inch from L 4.

(c) Modify ing the Tuning Capacitor:

In order to provide sufficient spread of the 10-meter band, it is necessary to reduce the capacitance of each section of the tuning capacitor. This is accomplished by removing all the rotor plates except the two end ones in each section. Care should be taken so as not to damage the remaining plates.

With two rotor plates in each section, the band spread for 27 to 30 Mc. will be approximately 3.5 to 4.7 on the calibrated dial. Using only one rotor plate per section, the 27 to 30 Mc. band will cover approximately the entire dial of the receiver.

To facilitate alignment of the receiver after modification, drill necessary holes (1/4") to expose the trimmer capacitor adjustment screws with the shields in place. Since the added cppacitance of the shields tends to detune the circuit, it is preferable to align the receiver with the coil shields in place.

It should be noted that the oscillator frequency must be tuned above the incoming frequency to obtain tracking over the entire dial.

(d) Changes in the Audio Circuit:

Unless the BFO (V-7 stage) is specifically desired, it should be converted to a first audio amplifier. This additional stage gives sufficient increase in audio gain for satisfactory speaker operation.

Even though some conversions use the existing RF gain control method (approximately 20K. variable between cathode and ground), it is generally preferred to have the RF gain remain maximum and use the conventional AF gain control. This is a convenient addition, especially if stage V-7 is changed to the first audio amplifier as mentioned above and as shown in Fig. 1. When the AF gain control is used, the cathode buss lead (labeled "gain control line") to pin #1 of J-1 is connected directly to ground.

With reference to Fig. 1 it will be noted that the 12A6 (V-8) is used as the output stage, R-C coupled to the first audio stage through the AF gain control. A conventional plate to voice-coil output transformer replaces the existing output transformer T1. The output transformer used must match the speaker voice-coil impedance to the required plate load impedance of the 12A6; this is approximately 7500 ohms. The existing output transformer, T1, is designed for a load impedance of either 300 ohms or 4000 ohms. These outputs were used for headphone reception.

V2 is a neon type, peak-limiting device and should be removed unless specifically desired.

For headphone reception with the above modification of the audio circuit, and open-circuiting type jack should be used at the plate output of the first audio amplifier. This jack is inserted between the coupling capacitor, C-29, and the grid of the 12A6.

(e) AVC Circuit:

For optimum signal to noise performance, the RF stage should operate at maximum gain. This requires removing the AVC voltage from this stage. To do this, disconnect R2 from the AVC line and ground at some convenient point. (R2 is V3 grid resistor.)

Due to the high gain of the RF and IF sections of this set, some AVC action is obtained from the existing circuit. (Diode action of control grid of second IF amplifier.) If more AVC is desired, it can be obtained from the unused diode plate of V-7 (12SR7) in the conventional manner. For this change refer to Fig. 1.

In using the diode section of V-7 for the AVC, it is necessary to remove R11 from the V-6 grid circuit. Refer to Fig. 1 for the added AVC components to V-7.

(f) Power Supply:

The most convenient AC power supply to use with these receivers is the one shown in Fig. 2. By using the cathode type rectifier (6X5), the 5 and 6.3 volt windings are used in series which gives approximately 12 volts for filament supply. This permits the use of the existing tubes with just minor changes in the filament circuit as shown in Fig. 2.

Correct polarity (phasing) of the two filament windings should be observed to obtain the proper additive voltage.

(g) Mechanical Modifications:

To complete the receiver conversion, the following mechanical modifications should be made:

The added controls, OFF-ON switch, volume control, and headphone jack should be brought out in the front panel. This is accomplished by removing all of the hardware of the J-1 plug assembly located on the front panel. An aluminum plate is mounted over the opening left by the J-1 plug and serves as a panel mount for the controls.

When removing J-1, all connecting leads can be removed from the set except the one labeled "gain control line" which is connected to pin #1. This lead is grounded as stated above in section (d).

With a bit of ingenuity and patience, the power supply can be located on the receiver chassis in the former dynamotor position. However, if the power supply is constructed as a separate component, the J-3 position can be used as the connecting plug.

All leads can be removed from J-2; lead to pin #2 is the filament lead and is connected to the new filament source.

It is apparent that the several components connected to J-3 are not needed for AC operation and can be removed to provide more space for the

modifications and additional parts as were the BFO components of the V-7 stage.

NOTE: For schematic diagram refer to Fig. 1 of the BC 946.

(h) Use of the BC-453A as a 'Q-5'er":

The BC-453A command receiver operates with an i.f. of 85 kc., which permits it to have an unusually sharp response characteristic. The normal method of using this receiver as a "Q-5'er" is to convert the audio system and the power supply as just described, and then to couple a shielded wire with a probe on the end into the communications receiver in the region of the last i-f stage. The BC-453 will operate, without modification, as a sharp i-f channel for any receiver having an intermediate frequency from 190 to 550 kc. Greatest selectivity will be obtained with the fiber rods which protrude from the center of the top of each of the i-f transformers pulled out as far as they will go for each of the three transformers. This degree of selectivity, which may be too much for comfortable listening to a phone contact, may be reduced by stagger tuning the i-f transformers slightly, or by pushing down one or more of the fiber rods.

The BC-453A may be operated in conjunction with a BC-348 as a sharp channel either by making modifications in the r-f coil assembly of the BC-453A or by using a frequency-converter stage. It is possible to remove turns from the coils in the r-f assembly until the front end of the receiver will tune to the 915-kc. i.f. of the BC-348. The alternative method of using the BC-453A in conjunction with the BC-348 is to use an outboard mixer stage between the output of the BC-348 and the input of the BC-453A. This mixer stage should accept the 915 kc. signal from the BC-348 and convert it, using conventional broadcast receiver components, to a frequency in the vicinity of 456 kc. for feeding to the input of the BC-453A. A 6SA7 tube is ideally suited to performing the frequency conversion which is required.

Audio Section for Converted SCR-274N (BC-453A) Series Receiver

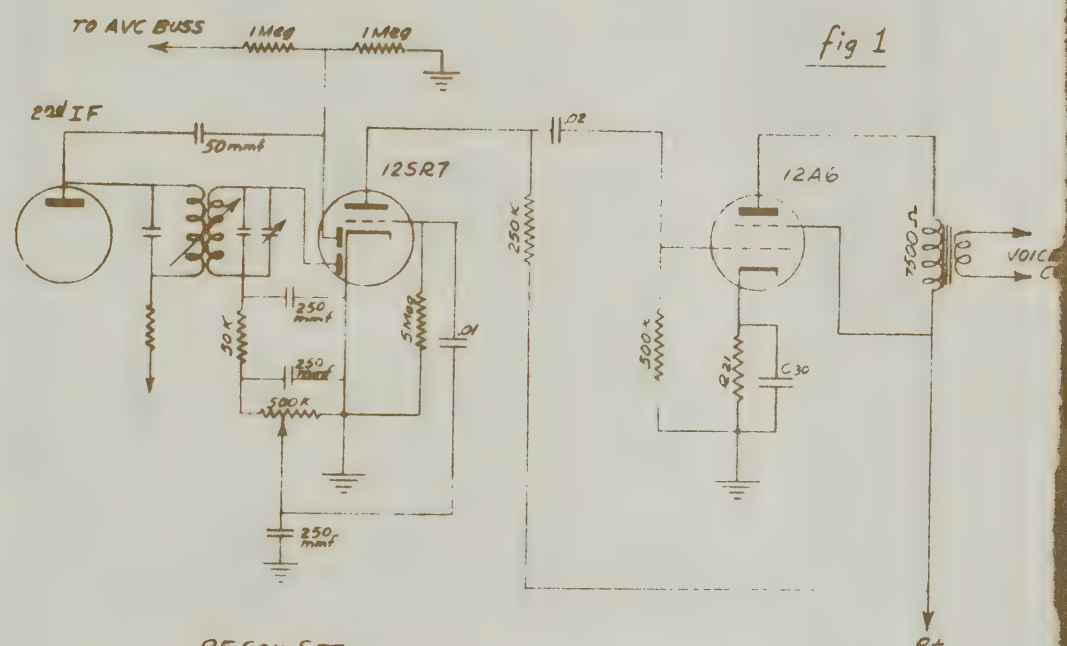
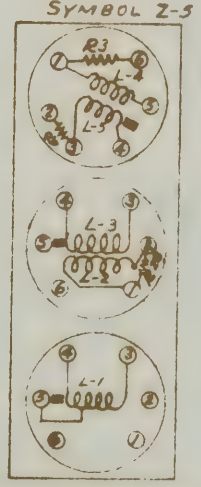


fig 1



Symbol Z-5C
RF OSC

Symbol Z-5B
RF AMP

Symbol Z-5A
RF ANT

NOTE: Should Noise Limiter Circuit be desired refer to conversion of BC-946, page 57

For original schematic diagram refer to BC-946, page 58

RESISTANCE TO GROUND FROM RECEIVER TERMINALS

Resistance to ground in ohms from all socket and receptacle terminals in the receivers. Use ohmmeter in Selective Analyzer Model 665, Type 2, part of Test Set I-56-A. Disconnect the receiver from the rack. Remove adapter and dynamotor.

Terminal	V-3 (Tube VT-131) R-F Amp.	V-4 (Tube VT-132) Mixer	V-5 (Tube VT-131) 1st I.F.	V-6 (Tube VT-131) 2nd I.F.	V-7 (Tube VT-133) Det.-CW Osc.	V-8 (Tube VT-134) Audio Amp.	J-1	J-2	J-3
1	0	0	0	0	0	0	300,000	0	0
2	0	8	8	0	51,000* 100,000*	8	0	8	330
3	300,000	14,000	300,000	510	0	15,000	H	14,000	300,000
4	H	7,000	100,000	100,000	510,000	14,000	330	—	314,000* 116,000*
5	300,000	52,000	300,000	510	0	2,000,000	314,000* 116,000*	—	7,000
6	7,000	520,000* 210,000*	7,000	7,000	334,000* 121,000*	H	8	—	H
7	8	8	8	8	8	8	H	—	14,000
8	14,000	620	14,000	14,000	0	1,500	H	—	—
Top Cap	—	**	—	—	—	—	—	—	—

*Upper value is for Radio Receiver BC-453-A (or -B), and lower is for Radio Receivers BC-454-A (or -B) and BC-455-A (or -B).

**Not over 20 ohms (the resistance of L-3).

NOTES: H signifies over 2 megohms, the practical limit of the ohmmeter. The value of 300,000 appears in several places; this is the leakage resistance of C-5. Apply positive lead of ohmmeter to C-5 and negative to ground for consistent results.

The resistance to ground from each terminal in Radio Control Boxes BC-450-A, BC-496-A and BC-473-A (or -B) (all switches in mid-position), the receiver rack, and Adapter FT-230-A is either 0 or H as follows:

J-4, all H; J-6, J-7, all H except 3; J-18, J-19, J-20, all H except 1; J-21, J-22, J-23, all H except 4; J-24, all H except 2, and J-25, J-26, J-27, all H except 3 and 4 (INCREASE OUTPUT control at maximum).

RESISTANCE TO GROUND FROM RECEIVER TERMINALS

Resistance to ground in ohms from all socket and receptacle terminals in the receivers. Use ohmmeter in Selective Analyzer Model 665, Type 2, part of Test Set I-56–A. Disconnect the receiver from the rack. Remove adapter and dynamotor.

Terminal	V-3 (Tube VT-131) R-F Amp.	V-4 (Tube VT-132) Mixer	V-5 (Tube VT-131) 1st I.F.	V-6 (Tube VT-131) 2nd I.F.	V-7 (Tube VT-133) Det.-CW Osc.	V-8 (Tube VT-134) Audio Amp.	J-1	J-2	J-3
1	0	0	0	0	0	0	300,000	0	0
2	0	8	8	0	51,000* 100,000*	8	0	8	330
3	300,000	14,000	300,000	510	0	15,000	H	14,000	300,000
4	H	7,000	100,000	100,000	510,000	14,000	330	—	314,000* 116,000*
5	300,000	52,000	300,000	510	0	2,000,000	314,000* 116,000*	—	7,000
6	7,000	520,000* 210,000*	7,000	7,000	334,000* 121,000*	H	8	—	H
7	8	8	8	8	8	8	H	—	14,000
8	14,000	620	14,000	14,000	0	1,500	H	—	—
Top Cap	—	**	—	—	—	—	—	—	—

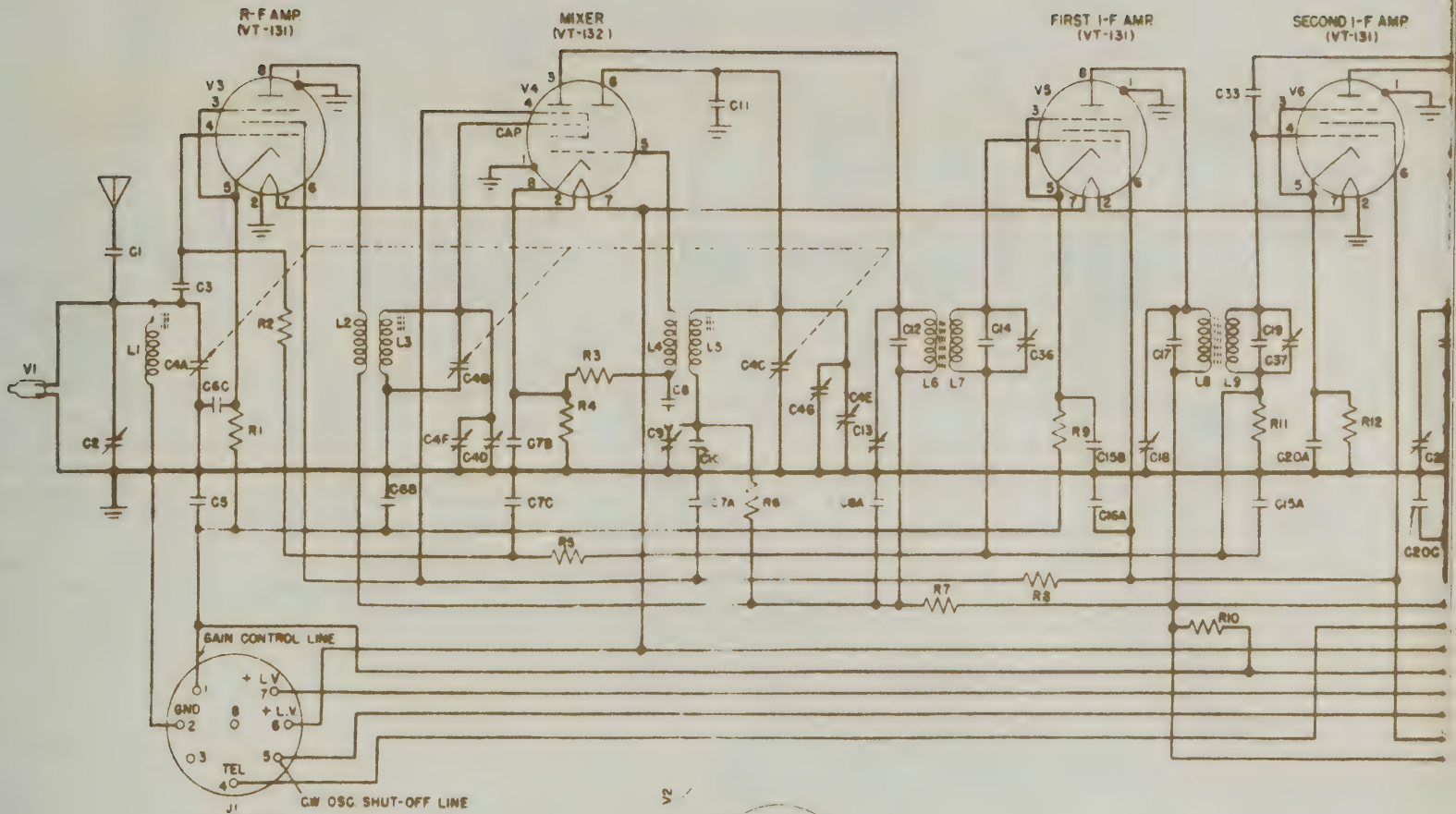
*Upper value is for Radio Receiver BC-453-A (or -B), and lower is for Radio Receivers BC-454-A (or -B) and BC-455-A (or -B).

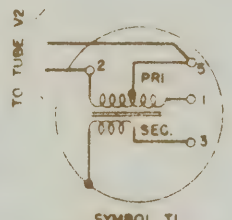
**Not over 20 ohms (the resistance of L-3).

NOTES: H signifies over 2 megohms, the practical limit of the ohmmeter. The value of 300,000 appears in several places; this is the leakage resistance of C-5. Apply positive lead of ohmmeter to C-5 and negative to ground for consistent results.

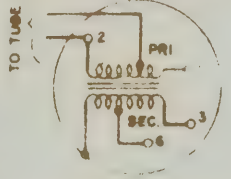
The resistance to ground from each terminal in Radio Control Boxes BC-450-A, BC-496-A and BC-473-A (or -B) (all switches in mid-position), the receiver rack, and Adapter FT-230-A is either 0 or H as follows:

J-4, all H; J-6, J-7, all H except 3; J-18, J-19, J-20, all H except 1; J-21, J-22, J-23, all H except 4; J-24, all H except 2, and J-25, J-26, J-27, all H except 3 and 4 (INCREASE OUTPUT control at maximum).



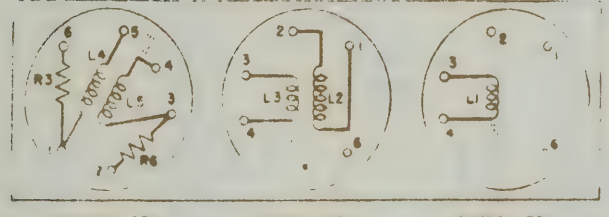


SYMBOL T1
OUTPUT TRANSFORMER
RADIO RECEIVER BC-454-A



SYMBOL T1
OUTPUT TRANSFORMER
RADIO RECEIVER BC-454-B

DETAIL SCHEMATIC DIAGRAMS
COIL ASSEMBLIES AND TRANSFORMERS



SYMBOL Z5C
R-F OSCILLATOR

SYMBOL Z5B
R-F AMPLIFIER

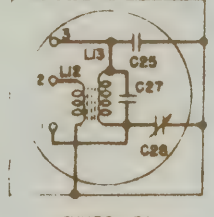
SYMBOL Z5A
R-F ANTENNA

R-F COIL UNIT (3-6 MC) SYMBOL Z5

SYMBOL Z1
1ST I-F
1415 KC

SYMBOL Z2
2ND I-F
1415 KC

SYMBOL Z3
3RD I-F
1415 KC



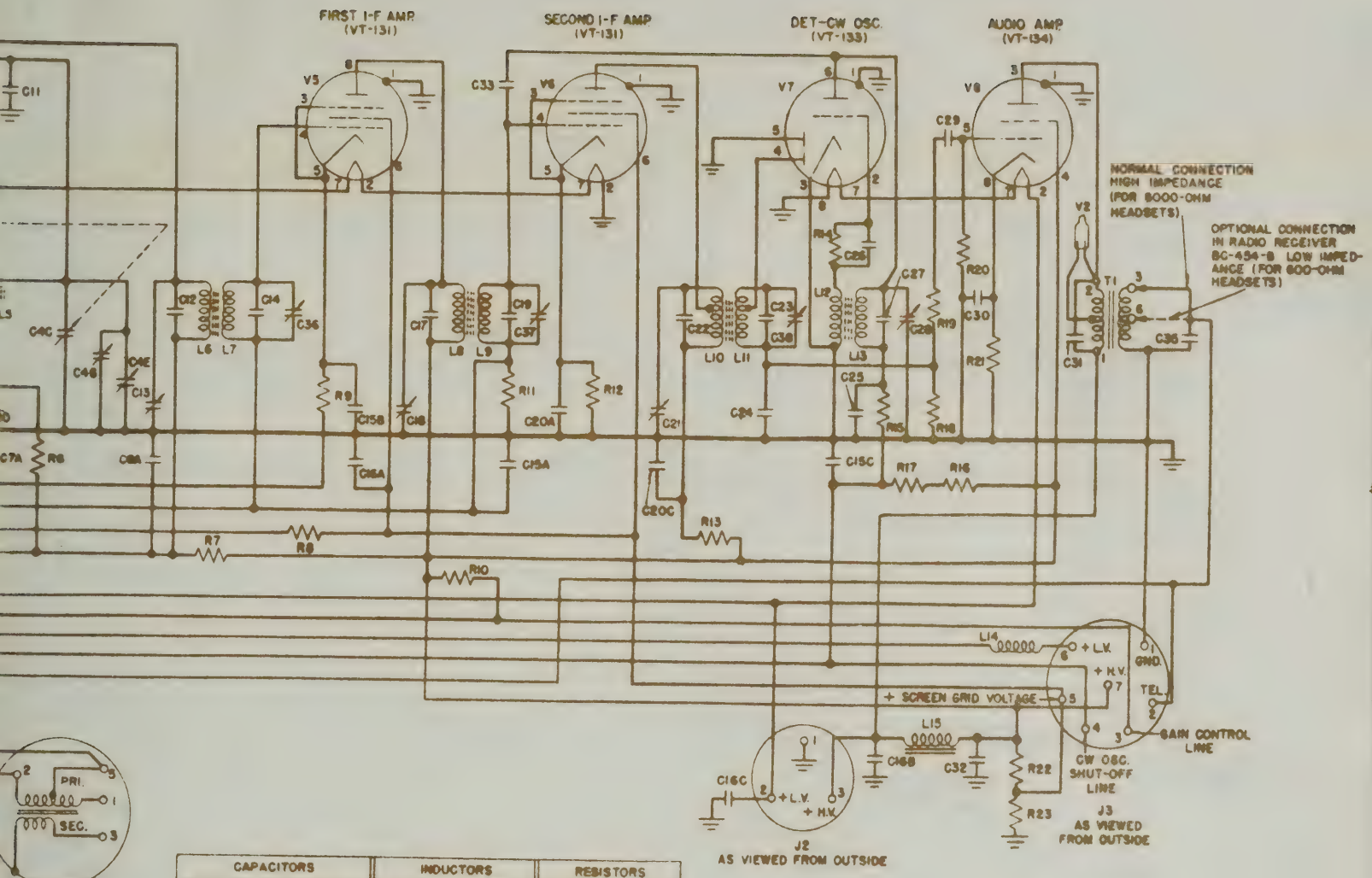
SYMBOL Z4
C W OSCILLATOR
1415 KC.

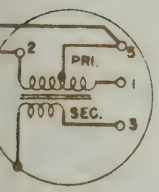
I-F COUPLING UNITS

CIRCUITS IN R COIL SET, I-F COUPLING UNITS, C W OSCILLATOR, AND OUTPUT TRANSFORMER. THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE PRACTICAL WIRING DIAGRAM

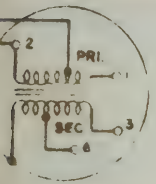
CAPACITORS		INDUCTORS		RESISTORS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C1	11 MMF	L1	ANT. INPUT	R1	620
C2	15 MMF	L2, L3	RF AMP	R2	2,000,000
C3	100 MMF	L4, L5	RF OSC	R3	51,000
C4 (A TO G)	GANG (147 MMF)	L6, L7	IN IST IF	R4	620
C5	3 MF	L8, L9	IN 2ND IF	R5	150,000
C6 (A,B,C)	.05/.05/.05 MF	L10, L11	IN 3RD IF	R6	200,000
C7 (A,B,C)	.05/.05/.05 MF	L12, L13	CW OSC.	R7	200
C8	200 MMF	L14	RF CHOKE, 112 MICRO-HENRIES	R8	200
C9	40 MMF			R9	620
C10	385 MMF	L15	AF CHOKE 3 HENRIES	R10	360,000
C11	3 MMF			R11	100,000
C12	180 MMF			R12	510
C13	17 MMF			R13	200
C14	180 MMF			R14	100,000
C15 (A,B,C)	.05/.05/.05 MF			R15	5100
C16 (A,B,C)	.22/.22/.22 MF			R16	51,000
C17	180 MMF			R17	51,000
C18	17 MMF			R18	510,000
C19	180 MMF			R19	100,000
C20 (A,B,C)	.05/.01/.05 MF			R20	2,000,000
C21	17 MMF			R21	1500
C22	180 MMF			R22	7000
C23	180 MMF			R23	7000
C24	200 MMF				
C25	.001 MF				
C26	100 MMF				
C27	180 MMF				
C28	34 MMF				
C29	.006 MF				
C30	15 MF				
C31	.001 MF				
C32	5 MF				
C33	*				
C35	750 MMF				
C36	17 MMF				
C37	17 MMF				
C38	17 MMF				

* WIRING CAPACITANCE (LESS THAN 2 MMF.).

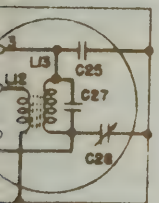

FIRST I-F AMP (VT-131)
SECOND I-F AMP (VT-131)
DET-CW OSC. (VT-133)
AUDIO AMP (VT-134)
NORMAL CONNECTION HIGH IMPEDANCE (FOR 8000-OHM HEADSETS)
OPTIONAL CONNECTION IN RADIO RECEIVER BC-454-B LOW IMPEDANCE (FOR 600-OHM HEADSETS)
+ SCREEN GRID VOLTAGE
GAIN CONTROL LINE
CW OSC. SHUT-OFF LINE
J2 AS VIEWED FROM OUTSIDE
J3 AS VIEWED FROM OUTSIDE



SYMBOL T1
TPUT TRANSFORMER
RECEIVER BC-454-A



SYMBOL T1
PUT TRANSFORMER
RECEIVER BC-454-B

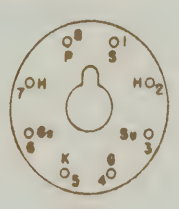


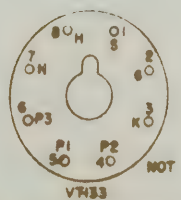
SYMBOL Z4
W OSCILLATOR
1415 KC.

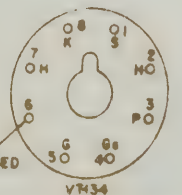
NSFORMER
ORRESPONDING

CAPACITORS		INDUCTORS		RESISTORS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C1	11 MMF.	L1	ANT. INPUT	R1	820
C2	15 MMF	L2, L3	RF AMP	R2	2,000,000
C3	100 MMF.	L4, L5	RF OSC	R3	51,000
C4 (A TO G)	GANG (147 MMF)	L6, L7	IN 1ST IF	R4	820
C5	3 MF	L8, L9	IN 2ND IF	R5	150,000
C6 (A,B,C)	.05/.05/.05 MF	L10, L11	IN 3RD IF	R6	200,000
C7 (A,B,C)	.06/.06/.05 MF	L12, L13	CW OSC.	R7	200
C8	200 MMF.	L14	RF CHOKE, 112 MICRO-HENRIES	R8	200
C9	40 MMF			R9	820
C10	365 MMF	L15	AF CHOKE 3 HENRIES	R10	360,000
C11	3 MMF			R11	100,000
C12	180 MMF			R12	510
C13	17 MMF			R13	200
C14	180 MMF			R14	100,000
C15 (A,B,C)	.05/.05/.05 MF			R15	5100
C16 (A,B,C)	.22/.22/.22 MF			R16	51,000
C17	180 MMF			R17	51,000
C18	17 MMF			R18	510,000
C19	180 MMF			R19	100,000
C20 (A,B,C)	.05/.01/.05 MF			R20	2,000,000
C21	17 MMF			R21	1500
C22	180 MMF			R22	7000
C23	180 MMF.			R23	7000
C24	200 MMF				
C25	.001 MF				
C26	100 MMF				
C27	180 MMF.				
C28	34 MMF				
C29	.006 MF				
C30	15 MF				
C31	.001 MF				
C32	5 MF.				
C33	*				
C35	750 MMF.				
C36	17 MMF.				
C37	17 MMF				
C38	17 MMF				

* WIRING CAPACITANCE (LESS THAN 2 MMF.).





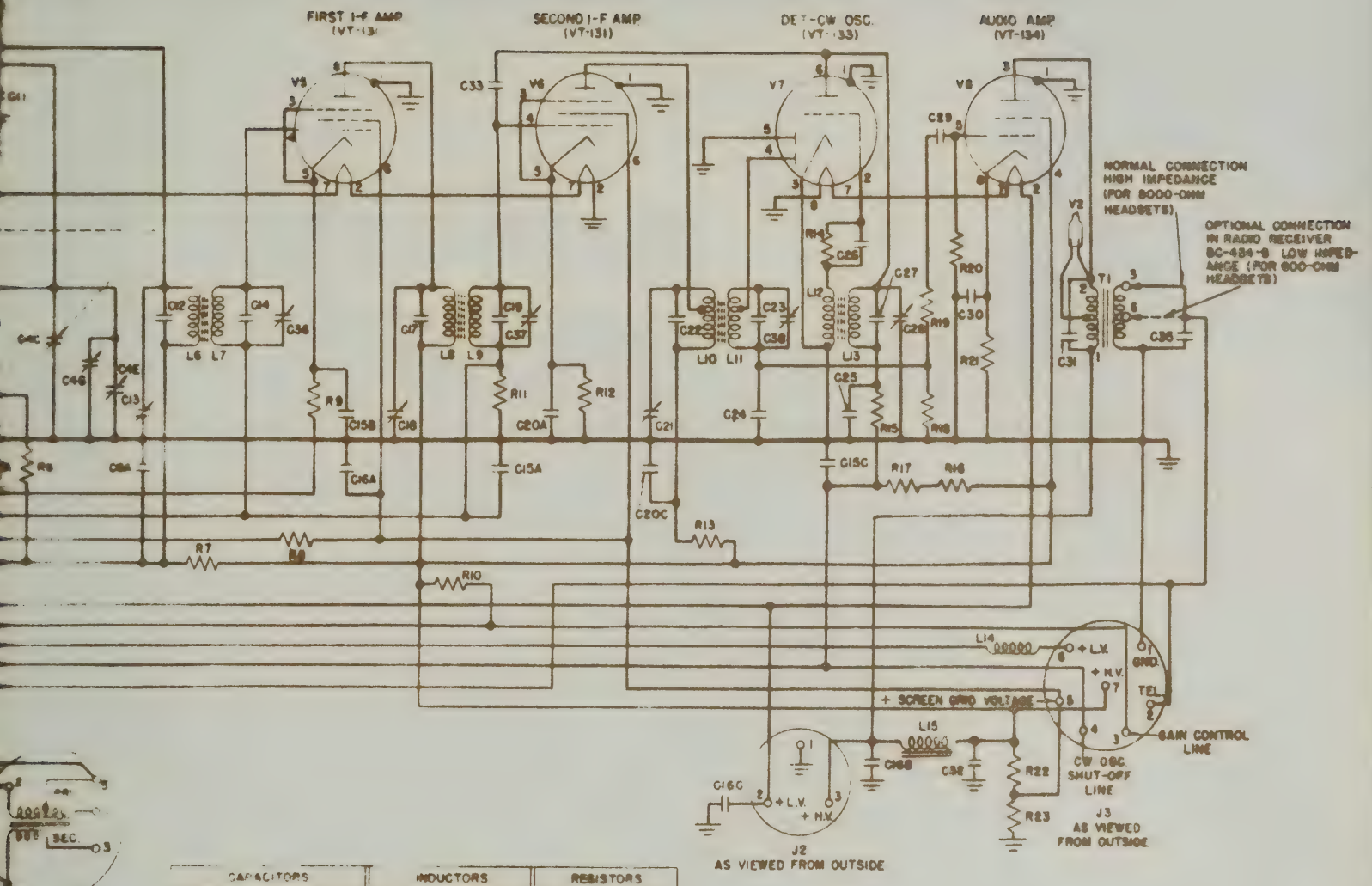


TUBE SOCKET TERMINALS AS VIEWED FROM BOTTOM

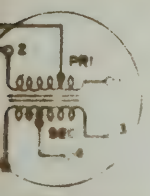
G = CONTROL GRID
G (HEX) = CONTROL GRID, HEXODE SECTION
G (OSC) = CONTROL GRID, OSC SECTION
G_2 = SCREEN GRID
G_2 (HEX) = SCREEN GRID, HEXODE SECTION
H = HEATER
K = CATHODE
P = PLATE
P (HEX) = PLATE, HEXODE SECTION
P (OSC) = PLATE, OSC SECTION
P1 = FIRST DIODE PLATE
P2 = SECOND DIODE PLATE
P3 = TRIODE PLATE ON TUBE VT-133
S = SHELL
S_u = SUPPRESSOR GRID

RADIO RECEIVER BC-454-A (OR -B) (3-6 MC) SCHEMATIC

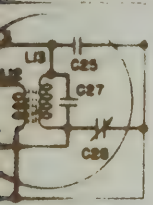
LTAGES IN THE RECEIVERS



SYMBOL T1
PUT TRANSFORMER
RECEIVER BC-454-A



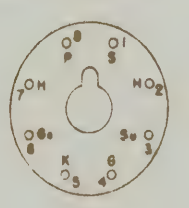
SYMBOL T1
PUT TRANSFORMER
RECEIVER BC-454-B

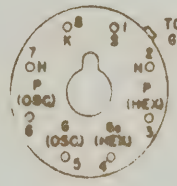


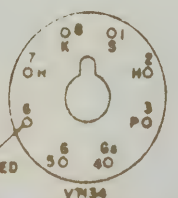
SYMBOL Z4
OSCILLATOR
KC

CAPACITORS		INDUCTORS		RESISTORS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C1	11 MMF	L1	ANT. INPUT	R1	620
C2	15 MMF	L2, L3	RF AMP	R2	2,000,000
C3	100 MMF	L4, L5	RF OSC.	R3	51,000
C4 (A TO G)	GANG (147 MMF)	L6, L7	IN 1ST I-F	R4	620
C5	3 MF	L8, L9	IN 2ND I-F	R5	150,000
C6 (A,B,C)	.05/.05/.05 MF	L10, L11	IN 3RD I-F	R6	200,000
C7 (A,B,C)	.05/.05/.05 MF	L12, L13	CW OSC.	R7	200
C8	200 MMF	L14	RF CHOKE, 112 MICRO-HENRIES	R8	200
C9	40 MMF	L15	AF CHOKE	R9	620
C10	365 MMF			R10	360,000
C11	3 MMF			R11	100,000
C12	180 MMF			R12	340
C13	17 MMF			R13	200
C14	180 MMF			R14	100,000
C15 (A,B,C)	.05/.05/.05 MF			R15	3400
C16 (A,B,C)	.22/.22/.22 MF			R16	51,000
C17	180 MMF			R17	51,000
C18	17 MMF			R18	510,000
C19	180 MMF			R19	100,000
C20 (A,B,C)	.05/.01/.05 MF			R20	2,000,000
C21	17 MMF			R21	1500
C22	180 MMF			R22	7000
C23	180 MMF			R23	7000
C24	200 MMF				
C25	.001 MF				
C26	100 MMF				
C27	180 MMF				
C28	34 MMF				
C29	.006 MF				
C30	.15 MF				
C31	.001 MF				
C32	5 MF				
C33	*				
C35	750 MMF				
C36	17 MMF				
C37	7 MMF				
C38	* MMF				

* WIRING CAPACITANCE (LESS THAN 2 MMF).



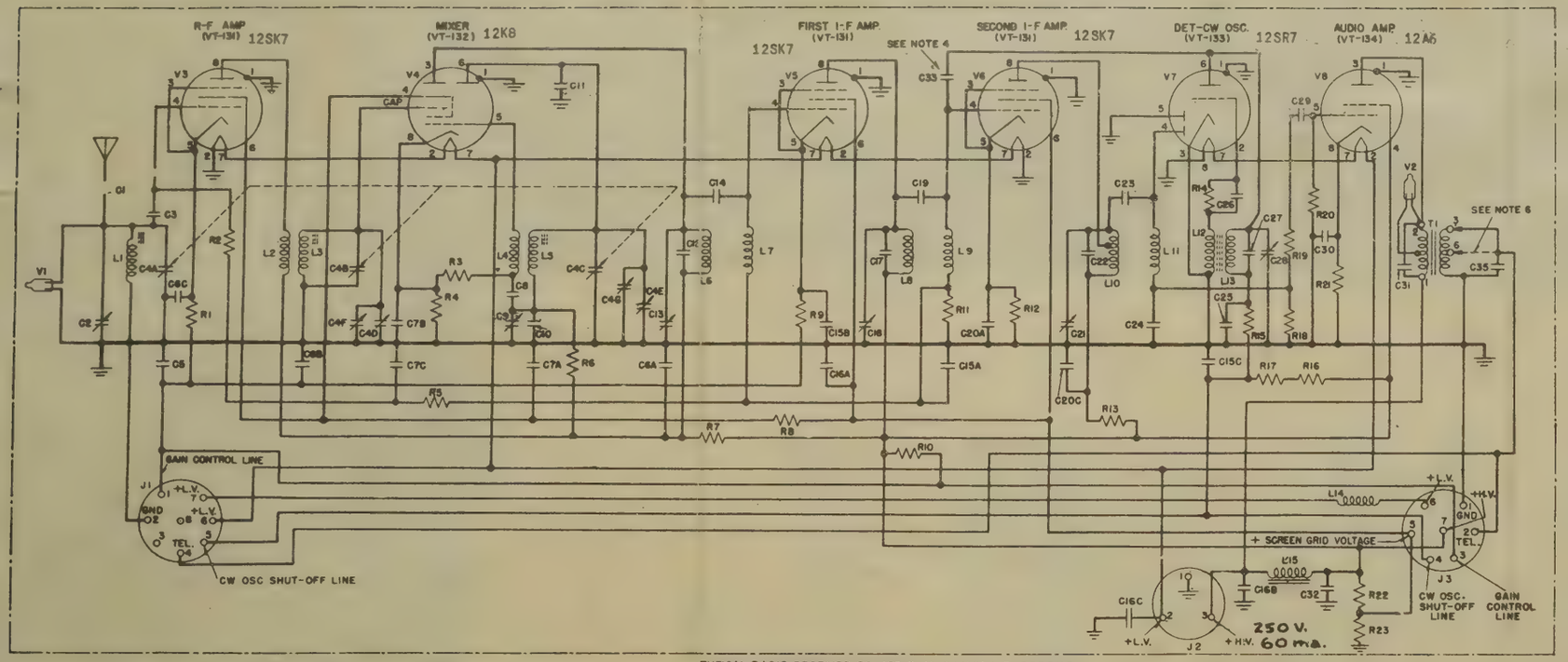




TUBE SOCKET TERMINALS AS VIEWED FROM BOTTOM

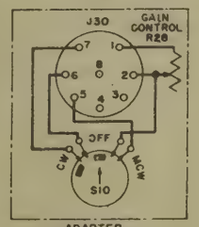
G = CONTROL GRID
G (HEX) = CONTROL GRID, HEXODE SECTION
G (OSC) = CONTROL GRID, OSC SECTION
Gs = SCREEN GRID
Gs (HEX) = SCREEN GRID, HEXODE SECTION
H = HEATER
K = CATHODE
P = PLATE
P (HEX) = PLATE, HEXODE SECTION
P (OSC) = PLATE, OSC. SECTION
P1 = FIRST DIODE PLATE
P2 = SECOND DIODE PLATE
P3 = TRIODE PLATE ON TUBE VT-133
S = SHELL
Su = SUPPRESSOR GRID

RADIO RECEIVER BC-454-A (OR -B) (3-6 MC) SCHEMATIC



TYPICAL RADIO RECEIVER BC-455-B (6-9.1 MC). I-F. 2830 KC

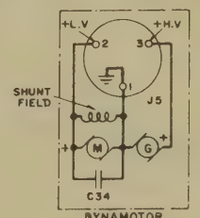
ADAPTER FT-230-A (REMOTE CONTROL)



ADAPTER FT-260-A (LOCAL CONTROL)

NOTES:

1. CAPACITOR ABBREVIATIONS:
   MMF - MICROMICROFARADS
   MF - MICROFARADS
2. ALL PLUGS AND RECEPTACLES ARE SHOWN AS VIEWED FROM THE OUTSIDE.
3. ALL RELAYS ARE SHOWN IN THE NON-ENERGIZED POSITION.
4. THE CAPACITANCE BETWEEN PIN PLUGS IN THE 2ND I-F RECEPTACLE CONSTITUTES C-33.
5. TERMINAL NUMBERS APPEARING ON RECEPTACLES OF JACKS IN RECEIVERS AND ADAPTERS AND ALL CIRCUIT SYMBOLS ARE FOR REFERENCE PURPOSES ONLY. THEY DO NOT APPEAR ON THE EQUIPMENT.
6. TRANSFORMER T1 IN BC-453-B, BC-454-B AND BC-455-B RECEIVERS IS PROVIDED WITH A TAP (TERM.6) FOR LOW IMPEDANCE HEADSETS. THESE THREE RECEIVERS AND RADIO RECEIVERS BC-453-A, BC-454-A AND BC-455-A ARE NORMALLY FURNISHED WITH CONNECTION SHOWN IN SOLID LINES FOR USE WITH HIGH IMPEDANCE (8000 OHMS) HEADSETS. RADIO RECEIVERS BC-453-B, BC-454-B, AND BC-455-B CAN BE CHANGED FOR USE WITH LOW IMPEDANCE HEADSETS BY REMOVING THE TWO WIRES ON TERMINAL 3 AND CONNECTING THEM TO TERMINAL 6 AS SHOWN IN DASHED LINES SEE FIG. 39.

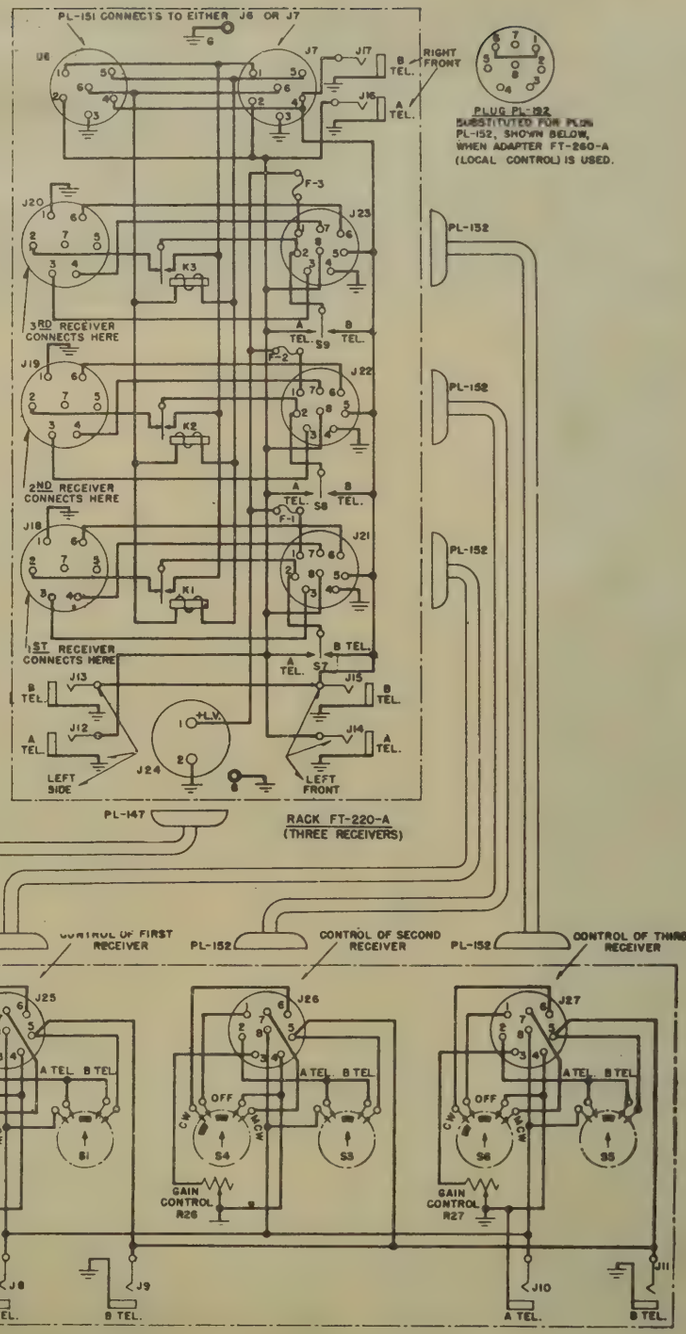


DYNAMOTOR DM-32-A

CAPACITORS						INDUCTORS		RESISTORS				MISCELLANEOUS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS	SYMBOL	OHMS	SYMBOL	DESCRIPTION
* C-1	8.5 MMF	C-15(ABC)	.05/.05/.05 MF	C-29	.006 MF	L-1	ANT. INPUT	R-1	620	* R-15	5,100	T-1	OUTPUT TRANSFORMER
C-2	15 MMF	C-16(ABC)	.22/.22/.22 MF	C-30	15 MF	L-2, L-3	RF AMP	R-2	2,000,000	* R-16	51,000		
C-3	100 MMF	C-17	180 MMF	C-31	.001 MF	L-4, L-5	RF OSC	R-3	51,000	* R-17	51,000	V-1, V-2	NEON TUBES
C-4(A TO C)	GANG 62 MMF	C-18	17 MMF	C-32	5 MF	L-6, L-7	IN 1ST IF	R-4	620	R-18	510,000	K-1, K-2, K-3	REC OUTPUT-TRANS. SIDE-TONE RELAYS
C-5	3 MF	C-19	180 MMF	* C-33	LESS THAN 2 MMF	L-8, L-9	IN 2ND IF	R-5	150,000	R-19	100,000		
C-6 (ABC)	.05/.05/.05 MF	C-20(ABC)	.05/.01/.05 MF			L-10, L-11	IN 3RD IF	* R-6	150,000	R-20	2,000,000		
C-7 (ABC)	.05/.05/.05 MF	C-21	17 MMF	C-34	.001 MF	L-12, L-13	CW OSC	R-7	200	R-21	1,500	F-1, F-2, F-3	10 AMP FUSES
C-8	200 MMF	C-22	180 MMF	C-35	750 MMF	L-14	RF CHOKE 112 μH	R-8	200	R-22	7,000		
C-9	40 MMF	C-23	180 MMF			L-15	AF CHOKE 3H	R-9	620	R-23	7,000		
* C-10	240 MMF	C-24	200 MMF					R-10	360,000				
C-11	3 MMF	C-25	.001 MF					R-11	100,000	R-25	0-50,000		
C-12	180 MMF	* C-26	100 MMF					R-12	510	R-26	0-50,000		
C-13	17 MMF	* C-27	185 MMF					R-13	200	R-27	0-50,000		
C-14	180 MMF	C-28	34 MMF					* R-14	100,000	R-28	0-50,000		

* VALUES SHOWN WITH AN ASTERISK VARY WITH THE RADIO RECEIVER. THOSE SHOWN IN THIS TABLE APPLY TO RADIO RECEIVER BC-455-B (6-9.1 MC) ONLY. ADDITIONAL CIRCUIT ELEMENTS WHICH MAY BE REQUIRED IN THE OTHER RADIO RECEIVERS ARE NOT SHOWN IN THE TABLE OR IN THE ABOVE SCHEMATIC CIRCUIT OF RADIO RECEIVER BC-455-B.

TYPICAL SCR-274N RECEIVER DIAGRAM



CONVERTING THE ARC-5 AND BC-454 SERIES RECEIVERS FOR OPERATION ON 10 METERS

The ARC-5 and BC-454 "Command Set" series receivers may be converted into 10-meter receivers that are hard to beat. They are especially well adapted for mobile use. One of these receivers can be used in conjunction with the ARC-5 transmitter on 10 meters, as described elsewhere in this manual, to make up a very economical mobile installation.

(a) General Description:

The receivers are very compact, light, and completely enclosed in an aluminum case. The basic circuit is that of a 6-tube superhet designed to obtain its "B" voltage from a 28-volt dynamotor normally clipped onto the rear of the chassis. (For additional data and other uses for these units, see Volume I of this manual.)

All units of the series are nearly identical with the exception of frequency coverage and intermediate frequencies, which are given in the following chart:

Navy	Army	Freq. Coverage	IF Freq.
	BC-453	190-550 kc.	85 kc.
	BC-946B	520-1500 kc.	239 kc.
R26/ARC5	BC-454	3-6 Mc.	1415 kc.
R27/ARC5	BC-455	6-9 Mc.	2830 kc.

The first two receivers listed are not recommended for 10-meter operation due to the low intermediate frequency.

The following instructions are applicable to all models. However, if the ARC-5 series is used special attention should be paid to the following points. The ARC-5 receivers differ from the BC-454 series in that they use a 12SF7 tube at V6 as the second IF and AVC, whereas the command sets use a 12SK7 as second IF and the AVC is taken from the 12SR7 stage. This causes some change in the audio circuit components, due to the different AVC circuits. A diagram (Fig. 3) is given of the ARC-5 after conversion.

(b) Filament Circuit Changes:

As the filaments were originally wired for 28-volt operation (in series parallel) it will be necessary to rewire them for 6-volt operation by placing all tubes in parallel with one side common to ground. The hot filament lead may be brought out on pin 6 of the rear plug. (Wires on this pin were part of the original filament circuit and may be removed.) All extra filament wiring as used in the original 28-volt system should be removed, along with the filament choke L-14.

The present 12-volt tubes should be replaced with their 6-volt equivalents as follows:

Original	Replacement
12SK7	6SK7
12K8	6K8
12SR7	6SR7 or 6SQ7
12A6	6K6, 6V6 or 6F6
ARC-5 Only-12SF7	6SF7

No changes in wiring are necessary when substituting 6-volt tubes.

(c) Removal of Present CW Oscillator Stage:

It is assumed that the CW oscillator will not be desired on 10 meters. Since this stage can be made into an additional stage of audio, all wires to terminals 6 and 2 of the 12SR7 tube and all wires to terminal 5 of the 12A6 should be removed. This operation causes the following component parts to be useless. Hence they may be removed. R14, C26, L12, L13, C27, C28, R15, R18, R19, R20, R16, R17, C29. It will be necessary to refer to the original circuit (Fig. 1) to locate and remove these parts. Once again some confusion may arise if the ARC-5 is being converted, so be careful to remove only the parts associated with the CW oscillator circuit.

(d) Addition of First Audio Stage:

The operation just accomplished causes the triode section of the 12SR7 tube to be free for use as a stage of resistance-coupled amplification. Refer to the circuit of Fig. 2 if the BC-454 series is used and to Fig. 3 if the ARC-5 is used.

The audio volume control included in the revision is mounted on the front panel in place of the original adapter plug, from which all wiring can be removed. However, the wire labeled "Gain Control Line" on the circuit diagram normally went through an external 50,000-ohm pot to ground for control of RF gain. In this conversion it is to be grounded directly to the chassis at some convenient point, allowing the RF gain to run wide open.

It will be noted that a 1N34 crystal-diode noise limiter is included in the circuit. This limiter is especially advisable if the receiver is to be used in an automobile. The noise-silencer switch is mounted in place of C5. (C5 may be used in the plate circuit of V7 after conversion.)

The present output transformer should be replaced, as the original one was designed to match headphones and will not match the ordinary PM speaker. A small universal matching transformer to couple the chosen output tube to a PM speaker should be installed.

(e) Antenna Post Modification:

It is advisable to remove the present antenna post and to replace it with a standard bayonet receptacle as used on most auto radios. For convenience, it is suggested that this receptacle be installed on the side of the receiver instead of on the front.

Note: The above modifications will allow operation on the original frequency of the unit merely by applying heater and plate voltage; however, for 10-meter operation the RF section must be modified further as follows:

(f) RF Components:

Remove the plug-in RF assembly consisting of the 3 coils enclosed in the metal shield cans. Work on one coil at a time. It will be necessary to remove the metal slug in each coil to facilitate rewinding. The slug is replaced when rewinding is finished.

L1 (Ant coil) Remove the existing winding and rewind with 6 turns of No. 18 enameled wire, space wound the full length of the coil form.

L2 (Honeycomb mixer coil) Remove the existing honey-comb coil with the exception of the last layer. This will leave approximately 9 turns for L2. This should be interwound with L3 after L3 has been rewound as in the next step. (Added sensitivity will be gained by interwinding the coils.)

L3 (On same form as L2) Remove the existing winding and rewind with 5 turns of No. 18 enameled wire, space wound the full length of the coil form. (Now interwind L2 with L3.)

L4 (Osc coil - small winding) No alteration necessary.

L5 (Osc coil - on same form as L4) Remove the existing winding and rewind with 5 turns of No. 18 enameled wire close spaced. L5 should be between 1/8" and 3/16" from L4.

In order to provide sufficient spread of the 10-meter band, it is necessary to reduce the capacitance of each section of the tuning condenser. This is accomplished by pulling off all rotor plates with the exception of the slotted one at the end of each section. This can be done with a pair of long nosed pliers without removing the condenser. Using a single plate in each section of the condenser, the band spread should be about 27 to 30 Mcs on the calibrated dial. The original dial plate should be removed by loosening the retaining nut, and replaced with a round piece of lucite or metal on which the 10-meter calibration may be marked.

If not already provided, holes should be drilled in the RF section shield to expose the trimmer condensers with the shield in place. Otherwise, the added capacitance of the shield would detune the circuits.

At this point the receiver is capable of operation providing power is applied. (See following section on power supplies.) The alignment is quite simple. The receiver should operate smoothly over the band. If it does not oscillate, reverse the connections to the oscillator coil winding. If the receiver is sensitive only in spots instead of over the entire range, take a turn at a time off the oscillator coil or coils until the receiver tracks. (The oscillator must be tuned above the incoming frequency to obtain proper tracking.) Normally the oscillator can be made to track properly by adjustment of the oscillator trimmer, but sometimes a turn or so must be taken off the coil to increase its frequency.

If the RF trimmer appears to have no effect, take a turn at a time from the center coil (small wire) until the trimmer gives a definite peak in output.

The oscillator padder should be adjusted for maximum output while the tuning dial is rocked back and forth. The oscillator trimmer may be used to move the 10-meter band into the limits of the dial desired.

The 2-meg. grid resistor of V3 should be detached from the AVC circuit and grounded to give a better signal/noise ratio.

(g) Power Supplies:

A simple power supply circuit for use with the receiver is shown in Fig. 4. A vibrator supply can be used if mobile operation is desired. Also, for mobile operation the voltages can be taken from the existing broadcast receiver thus eliminating the need for an extra supply. In this case it is necessary to place a switch in the broadcast receiver to remove its load from the power supply when the 10 meter receiver is being used.

(h) Rack Mounting:

For mobile installations, the FT220A rack may be used to mount the receiver, making it an easy matter to take out and repair the set. This rack was designed to take 3 receivers so it will be necessary to saw off one and rewire it to suit the plug connections used on the receiver. The switch on the front of the rack may be used for a standby switch and the fuse block on the rear will be handy for a battery lead fuse.

Modified Audio Section of BC-454 Receiver

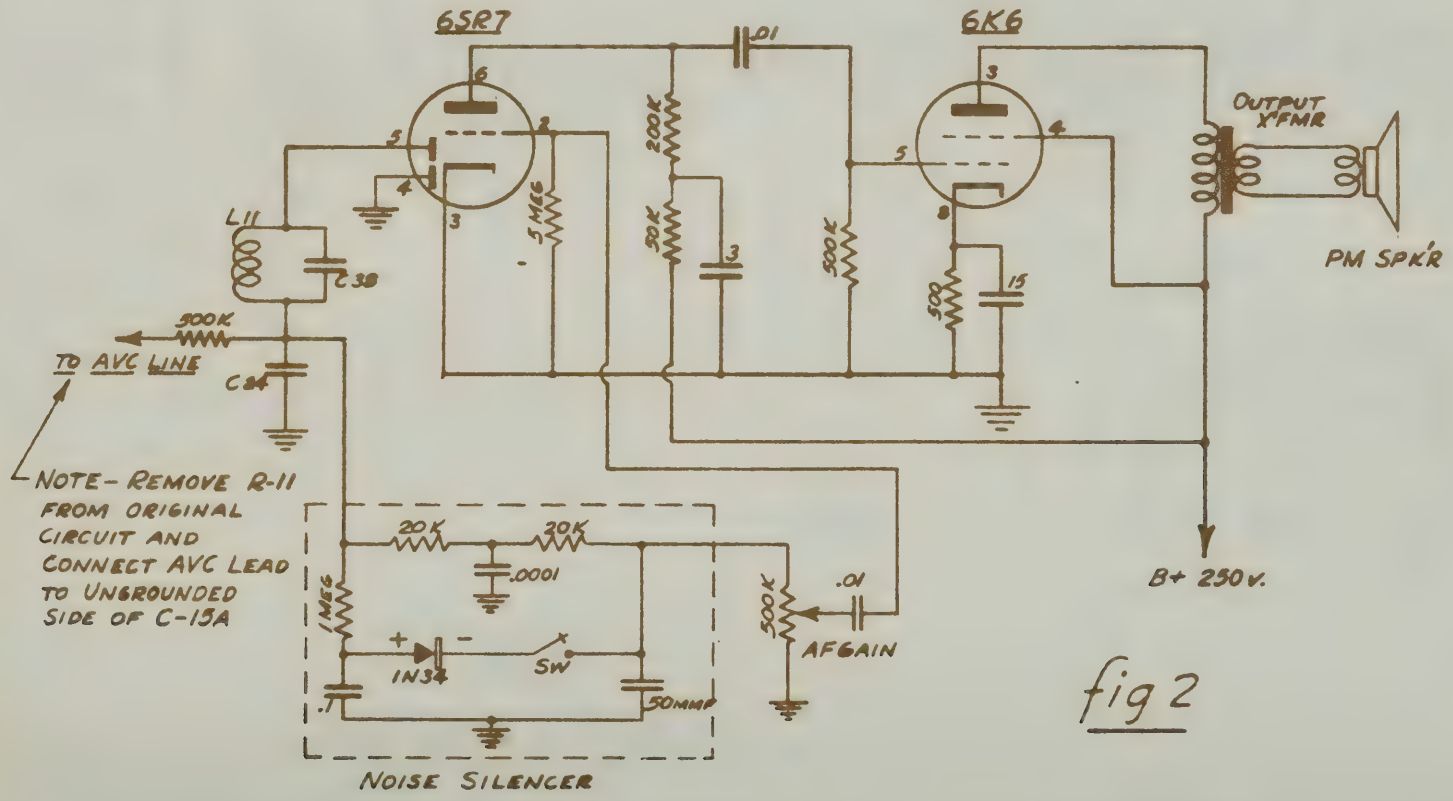


fig 2

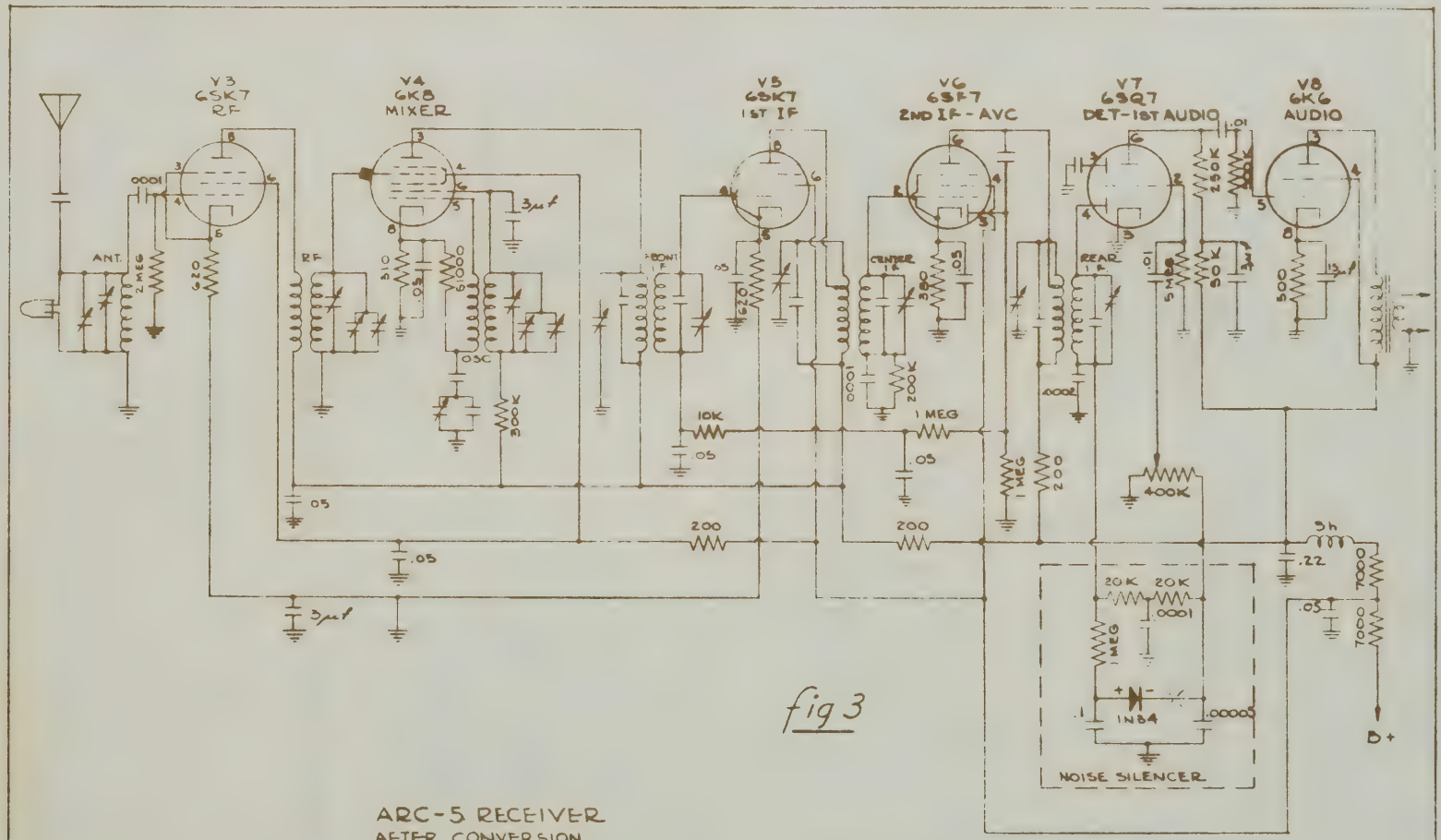
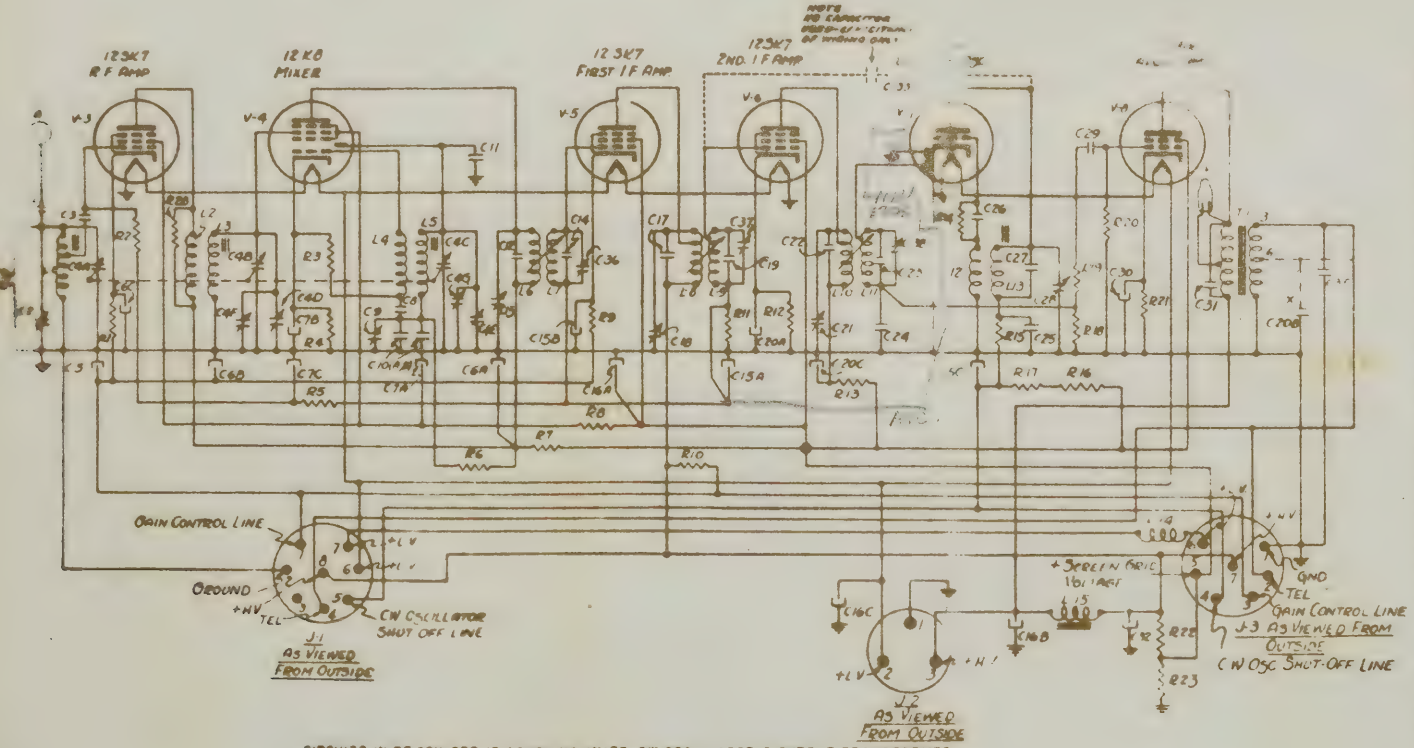


fig 3

ARC-5 RECEIVER
AFTER CONVERSION
TO 10 METERS

ORIGINAL SCHEMATIC IDENTICAL TO
BC-946B EXCEPT FOR V6 + AVC



CAPACITANCES		INDUCTANCES		RESISTANCES	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C-1	11 MMF	L-1	ANT INPUT	R-1	620
C-2	18 MMF	L-2, L-3	RF AMP	R-2	2,000,000
C-3	.00 MMF	L-4, L-5	R F OSC	R-3	51,000
C-4(A TO C)	GANG(346 MMF)	L-6, L-7	IN FIRST IF	R-4	620
C-5	3 MFD	L-8, L-9	IN 2ND IF	R-5	150,000
C-6(A,B,C)	05/05/05 MFD	L-10, L-11	IN 3RD IF	R-6	300,000
C-7(A,B,C)	05/05/05 MFD	L-12, L-13	CW OSC	R-7	200
C-8	200 MMF	L-14	RF CHOKE	R-8	200
C-9	40 MMF		112 MICRO-	R-9	620
C-10 (A,B)	670 MMF TOTAL		HENRIES	R-10	360,000
C-11	3 MMF	L-15	AF CHOKE	R-11	100,000
C-12	180 MMF		3 HENRIES	R-12	510
C-13	17 MMF			R-13	200
C-14	180 MMF			R-14	100,000
C-15(A,B,C)	05/05/05 MFD			R-15	20,000
C-16(A,B,C)	22/22/22 MFD			R-16	100,000
C-17	180 MMF			R-17	100,000
C-18	17 MMF			R-18	510,000
C-19	180 MMF			R-19	100,000
C-20(A,B,C)	05/01/05 MFD			R-20	3,000,000
C-21	17 MMF			R-21	1500
C-22	180 MMF			R-22	7000
C-23	180 MMF			R-23	7000
C-24	200 MMF			R-24	51,000
C-25	001 MFD				
C-26	100 MMF				
C-27	338 MMF				
C-28	34 MMF				
C-29	006 MFD				
C-30	15 MFD				
C-31	001 MFD				
C-32	5 MFD				
C-33	WIRING CAPAC- ITANCE LESS THAN 2 MMF				
C-34	750 MMFD (SEE NOTE BELOW)				
C-36	17 MMF				
C-37	17 MMF				
C-38	17 MMF				

CIRCUITS IN RF COIL SET, IF COUPLING UNITS, CW OSCILLATOR, & OUTPUT TRANSFORMER THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE WIRING DIAGRAM

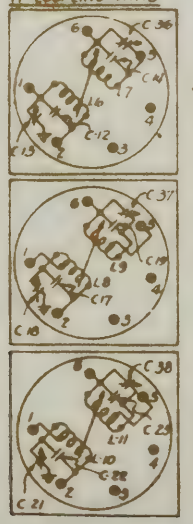
RF Coil Set Symbol Z-5

Symbol Z-5C RF Oscillator

Symbol Z-5B RF Amplifier

Symbol Z-5A RF Antenna

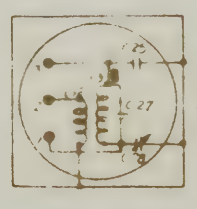
IF Coupling Units



Symbol Z-1 1st IF (239 KC)

Symbol Z-2 2nd IF (239 KC)

Symbol Z-3 3rd IF (239 KC)



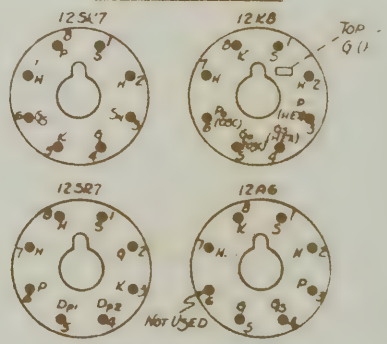
Symbol Z-4 CW Oscillator (239 KC)

Symbol T-1 Output Transformer

C 35 & Terminal 3 To Be Used For 4000 Ohm Output
C 20B & Terminal 6 To Be Used For 300 Ohm Output

FIG. 1

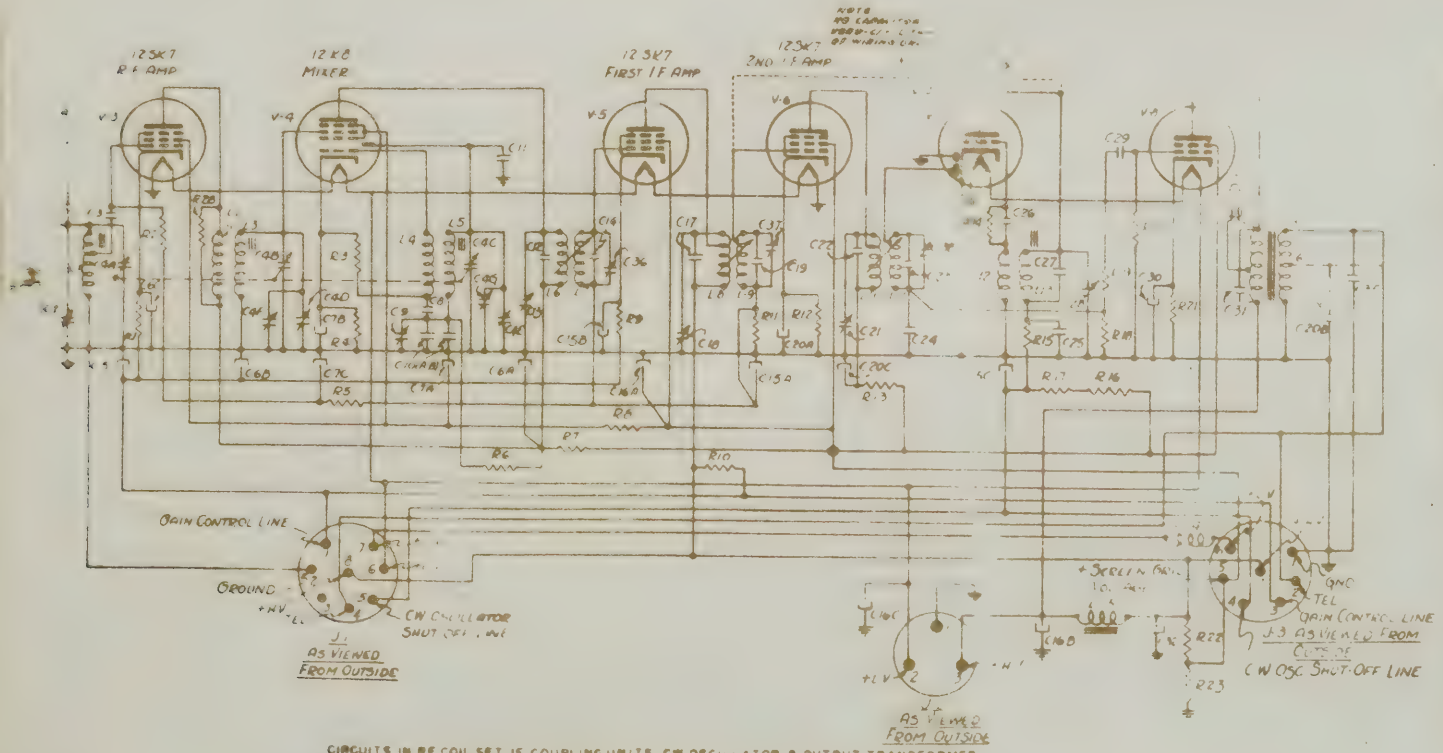
Tube Socket Terminals As Viewed From Bottom



Tube Terminal Code

S = Shell
H = Heater
K = Cathode
S_4 = Suppressor Grid
D_{P1} = First Diode Plate
D_{P2} = Second Diode Plate
G = Control Grid
G_3 = Screen Grid
G_3 (HEX) = Screen Grid, Hexode
G_1 (OSC) = Control Grid, Osc.
P = Plate
P (HEX) = Plate, Hexode Sect.
P_h (OSC) = Plate, Osc. Section
G (HEX) = Control Grid, (Hex.)

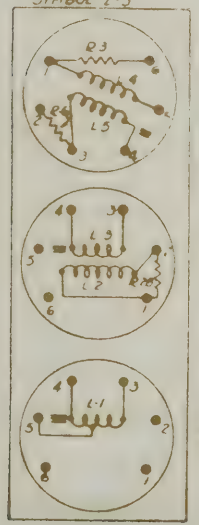
Radio Receiver BC-454 - Schematic Wiring Diagram



CAPACITANCES		INDUCTANCES		RESISTANCES	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C-1	11 MMF	L-1	ANT INPUT	R-1	620
C-2	18 MMF	L-2, L-3	RF AMP	R-2	2,000,000
C-3	00 MMF	L-4, L-5	RF OSC	R-3	51,000
C-4(A TO [illegible]GANG)(346 MMF)		L-6, L-7	IN FIRST IF	R-4	820
C-5	3 MFD	L-8, L-9	IN 2ND IF	R-5	150,000
C-6(A,B,C)	05/08/08 MFD	L-10, L-11	IN 3RD IF	R-6	300,000
C-7(A,B,C)	05/05/05 MFD	L-12, L-13	CW OSC	R-7	200
C-8	200 MMF	L-14	RF CHOKE	R-8	200
C-9	40 MMF		112 MICRO-	R-9	820
C-10 (AB)	670 MMF TOTAL		HENRIES	R-10	360,000
C-11	3 MMF	L-15	AF CHOKE	R-11	100,000
C-12	180 MMF		3 HENRIES	R-12	510
C-13	17 MMF			R-13	200
C-14	180 MMF			R-14	100,000
C-15(A,B,C)	05/05/05 MFD			R-15	20,000
C-16(A,B,C)	22/22/22 MFD			R-16	100,000
C-17	180 MMF			R-17	100,000
C-18	17 MMF			R-18	510,000
C-19	180 MMF			R-19	100,000
C-20(A,B,C)	05/01/05 MFD			R-20	2,000,000
C-21	17 MMF			R-21	1800
C-22	180 MMF			R-22	7000
C-23	180 MMF			R-23	7000
C-24	200 MMF			R-24	51,000
C-25	001 MFD				
C-26	100 MMF				
C-27	335 MMF				
C-28	34 MMF				
C-29	006 MFD				
C-30	15 MFD				
C-31	001 MFD				
C-32	5 MFD				
C-33	WIRING CAPAC-ITANCE LESS THAN 2 MMF				
C-34	780 MMFD (SEE NOTE BELOW)				
C-36	17 MMF				
C-37	17 MMF				
C-38	17 MMF				

CIRCUITS IN RF COIL SET, IF COUPLING UNITS, CW OSCILLATOR, & OUTPUT TRANSFORMER THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE WIRING DIAGRAM

RF Coil Set
Symbol Z-5



Symbol Z-5C
RF Oscillator

Symbol Z-5B
RF Amplifier

Symbol Z-5A
RF Antenna

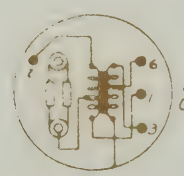
IF Coupling Units

Symbol Z-1
1st IF
(239 KC)

Symbol Z-2
2nd IF
(239 KC)

Symbol Z-3
3rd IF
(239 KC)

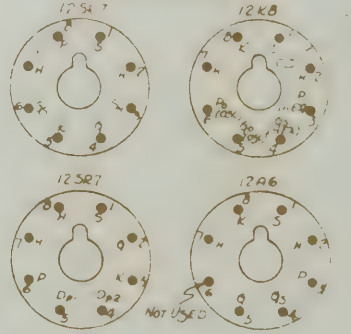
Symbol Z-4
CW Oscillator
(239 KC)



Symbol T-1
Output Transformer

FIG. 1

Tube Socket Terminals
As Viewed From Bottom

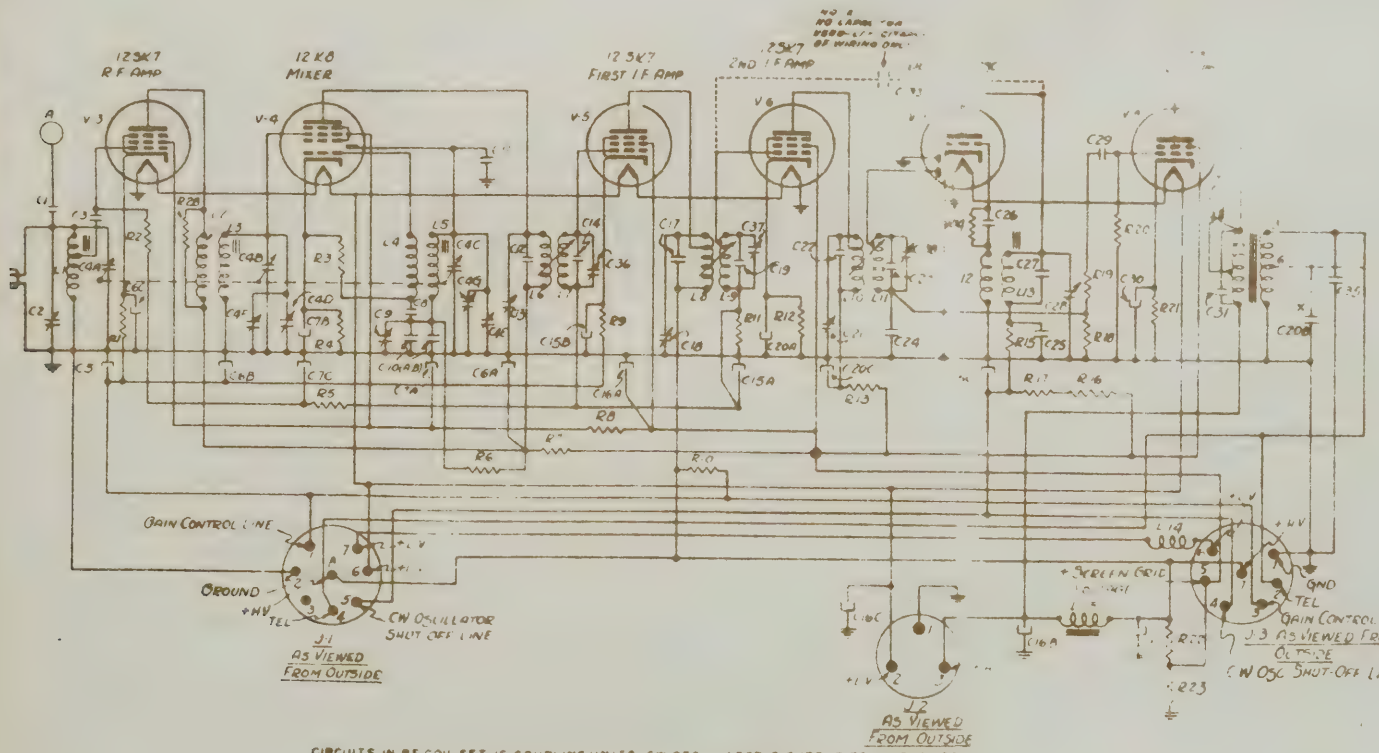


Tube Terminal Code

S = Shell
H = Heater
K = Cathode
S_G = Suppressor Grid
D_{P1} = First Diode Plate
D_{P2} = Second Diode Plate
G = Control Grid
G_3 = Screen Grid
G_5 (HEX) = Screen Grid, Hexode
G_6 (OSC) = Control Grid
P = Plate
P (HEX) = Plate, Hexode
P_6 (OSC) = Plate, Osc.
G (HEX) = Control Grid

④ C 35 & Terminal 3 To Be Used For 4000 Ohm Output
C 208 & Terminal 6 To Be Used For 300 Ohm Output

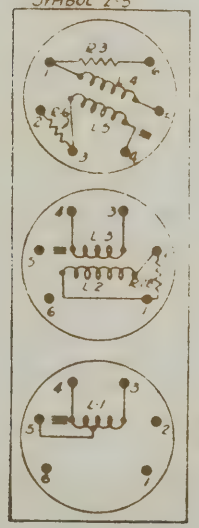
Radio Receiver BC-454 - Schematic Wiring Diagram



CAPACITANCES		INDUCTANCES		RESISTANCES	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C-1	11 MMF	L-1	ANT INPUT	R-1	620
C-2	18 MMF	L-2, L-3	R F AMP	R-2	2,000,000
C-3	100 MMF	L-4, L-5	R F OSC	R-3	51,000
C-4(A TO [illegible] BAND (346 MMF)		L-6, L-7	IN FIRST I F	R-4	620
C-5	3 MFD	L-8, L-9	IN 2ND I F	R-5	150,000
C-6(A,B,C)	05/05/05 MFD	L-10, L-11	IN 3RD I F	R-6	300,000
C-7(A,B,C)	05/05/05 MFD	L-12, L-13	C W OSC	R-7	200
C-8	200 MMF	L-14	R F CHOKE	R-8	200
C-9	40 MMF		1/2 MICRO-	R-9	620
C-10 (A8)	670 MMF TOTAL		HENRIES	R-10	360,000
C-11	3 MMF	L-15	A F CHOKE	R-11	100,000
C-12	180 MMF		3 HENRIES	R-12	510
C-13	17 MMF			R-13	200
C-14	180 MMF			R-14	100,000
C-15(A,B,C)	05/05/05 MFD			R-15	20,000
C-16(A,B,C)	22/22/22 MFD			R-16	100,000
C-17	180 MMF			R-17	100,000
C-18	17 MMF			R-18	810,000
C-19	180 MMF			R-19	100,000
C-20(A,B,C)	05/01/05 MFD			R-20	2,000,000
C-21	17 MMF			R-21	1900
C-22	180 MMF			R-22	7000
C-23	180 MMF			R-23	7000
C-24	200 MMF			R-24	51,000
C-25	001 MFD				
C-26	100 MMF				
C-27	335 MMF				
C-28	34 MMF				
C-29	006 MFD				
C-30	15 MFD				
C-31	001 MFD				
C-32	5 MFD				
C-33	WIRING CAPAC-ITANCE LESS THAN 2 MMF				
C-35	750 MMFD (SEE NOTE BELOW)				
C-36	17 MMF				
C-37	17 MMF				
C-38	17 MMF				

CIRCUITS IN R F COIL SET, I F COUPLING UNITS, C W OSCILLATOR, & OUTPUT TRANSFORMER THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE WIRING DIAGRAM

R F Coil Set
Symbol Z-5



Symbol Z-5C
R F Oscillator

Symbol Z-5B
R F Amplifier

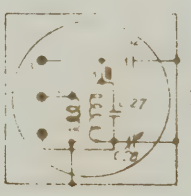
Symbol Z-5A
R F Antenna

I F Coupling Units

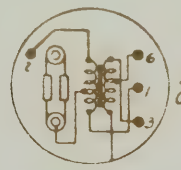
Symbol Z-1
1st I F
(239 KC)

Symbol Z-2
2nd I F
(239 KC)

Symbol Z-3
3rd I F
(239 KC)



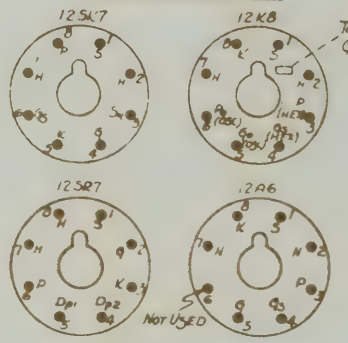
Symbol Z-4
C W Oscillator
(239 KC)



Symbol T-1
Output Transformer

FIG. 1

Tube Socket Terminals
As Viewed From Bottom

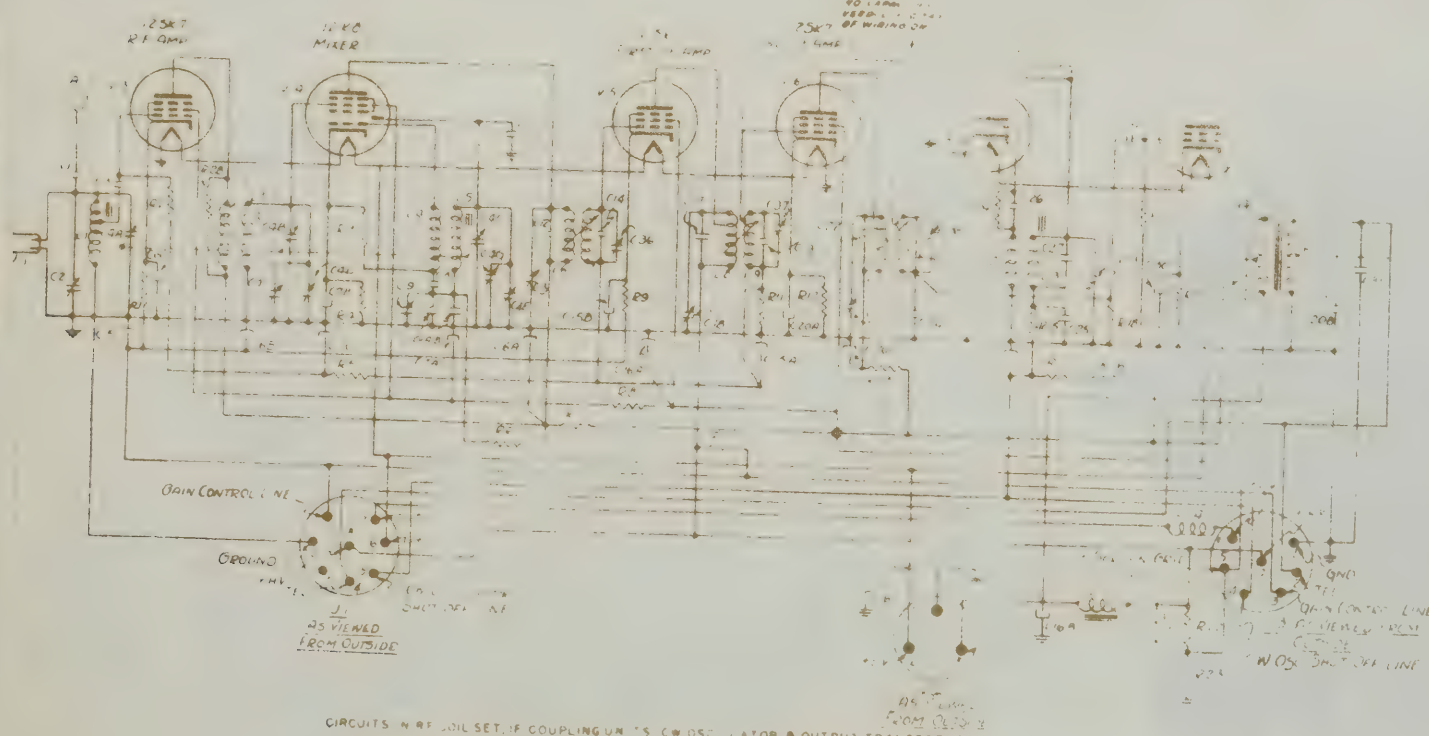


Tube Terminal Code

S = Shell
H = Heater
K = Cathode
S_g = Suppressor Grid
D_{p1} = First Diode Plate
D_{p2} = Second Diode Plate
G = Control Grid
G_3 = Screen Grid
G_5 (HEX) = Screen Grid, Hexode Section
G_6 (OSC) = Control Grid, Osc Section
P = Plate
P (HEX) = Plate, Hexode Section
P_6 (OSC) = Plate, Osc Section
G (HEX) = Control Grid, (Hexode Se[illegible]

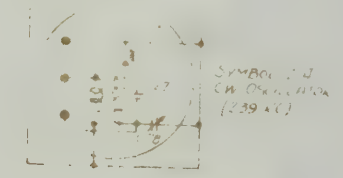
④ C 35 & Terminal 3 To Be Used For 4000 Ohm Output
C 208 & Terminal 6 To Be Used For 300 Ohm Output

Radio Receiver BC-454 - Schematic Wiring Diagram



CAPACITANCES		INDUCTANCES		RESISTANCES	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C-1	11 MMF	L-1	ANT INPUT	R-1	620
C-2	18 MMF	L-2, L-3	RF AMP	R-2	2,000,000
C-3	100 MMF	L-4, L-5	RF OSC	R-3	5,000
C-4(A TO C) GANG (34 MMF)		L-6, L-7	IN FIRST IF	R-4	620
C-5	1 MMF	L-8, L-9	IN 2ND IF	R-5	150,000
C-6(A,B,C)	.05, .05, .05 MFD	L-10, L-11	IN 3RD IF	R-6	300,000
C-7(A,B,C)	.05/.05, .01 MFD	L-12, L-13	1ST OSC	R-7	200
C-8	220 MMF	L-14	RF CHOKE	R-8	20[illegible]
C-9	40 MMF		12 MICRO	R-9	62[illegible]
C-10(A&B)	670 MMF TOTAL		HENRIES	R-10	16[illegible]
C-11	3 MMF	L-15	AF CHOKE	R-11	[illegible]
C-12	180 MMF		3 HENRIES	R-12	5
C-13	17 MMF			R-13	200
C-14	180 MMF			R-14	100,000
C-15(A,B,C)	.05, .05, .05 MFD			R-15	20,000
C-16(A,B,C)	.22/.22/.22 MFD			R-16	100,000
C-17	180 MMF			R-17	100,000
C-18	17 MMF			R-18	510,000
C-19	180 MMF			R-19	100,000
C-20(A,B,C)	.05/.01, .05 MFD			R-20	2,000,000
C-21	17 MMF			R-21	1500
C-22	180 MMF			R-22	7000
C-23	180 MMF			R-23	7000
C-24	200 MMF			R-24	51,000
C-25	.001 MFD				
C-26	100 MMF				
C-27	535 MMF				
C-28	34 MMF				
C-29	.006 MFD				
C-30	.15 MFD				
C-31	.001 MFD				
C-32	.5 MFD				
C-33	WIRING CAPACITANCE LESS THAN 2 MMF				
C-34	750 MMFD (SEE NOTE BELOW)				
C-35	17 MMF				
C-37	17 MMF				
C-38	17 MMF				

CIRCUITS IN RF COIL SET, IF COUPLING UNITS, CW OSCILLATOR, & OUTPUT TRANSFORMER
THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE
CORRESPONDING LOCATIONS ON THE WIRING DIAGRAM



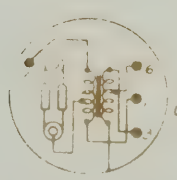
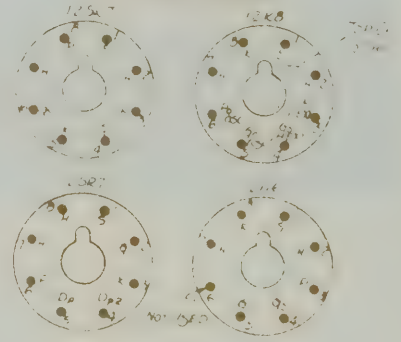


FIG. 1

Ⓐ C-35 & TERMINAL 3 TO BE USED FOR 4000 OHM OUTPUT
C-20B & TERMINAL 6 TO BE USED FOR 500 OHM OUTPUT



TUBE TERMINAL CODE

S = SHELL
H = HEATER
K = CATHODE
S.G. = SUPPRESSOR GRID
Dp1 = FIRST DIODE PLATE
Dp2 = SECOND DIODE PLATE
G = CONTROL GRID
G5 = SCREEN GRID
G5 (HEX) = SCREEN GRID, HEXODE SECTION
G0 (OSC.) = CONTROL GRID, OSC. SECTION
P = PLATE
P (HEX) = PLATE, HEXODE SECTION
P0 (OSC.) = PLATE, OSC. SECTION
G1 = CONTROL GRID, HEXODE SECTION

Radio Receiver BC-454 - Schematic Wiring Diagram

WA4BXZ
J. D. HATTAWAY
3005 CLIFFSIDE
KINGSPORT, TENN.

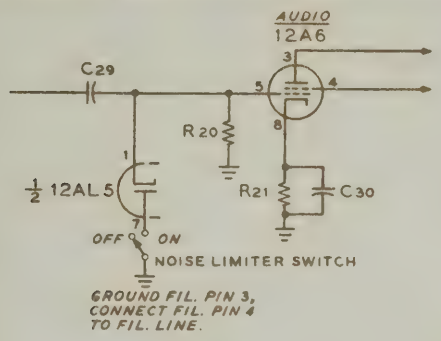


Figure 9
SCHEMATIC, NOISE LIMITER FOR COMMAND RECEIVER.

The coil rack is removed and the following alterations are made to the coils:

1—Remove 210 turns from the antenna coil (L-1).
2—Remove 500 turns from the mixer coil primary (L-2).
3—Remove 220 turns from the mixer coil secondary (grid).
4—Remove 195 turns from the oscillator coil secondary (L-5).

Do not remove any turns from oscillator coil primary (the grid winding). When completed, replace the coil rack. The receiver will now tune the frequency range of 550 kc.—1600 kc. Adjust high frequency alignment with the oscillator shunt padders (C-4E, C-4G) on the variable tuning capacitor. Track the low frequency end of the band with the adjustable powdered iron slug cores in the three coils, plus the oscillator series padder (C-9) on the end of the tuning capacitor.

A Noise Limiter for Your Command Set

Tired of automobile QRM or static on your Command set? A very simple but effective noise limiter can be connected as shown in figures 9 and 10. A 12AL5 tube is used. The cathode of one-half of the diode is connected to the 12A6 control grid. The grid of the 12A6 is slightly negative, so the diode does not conduct; however, when a noise peak arrives (or a strong audio peak) the diode conducts and shorts the grid circuit out to ground. The limiting action is as good as the more complicated shunt-type limiter, but the audio distortion is a little higher. A switch may be incorporated to remove the limiter from the circuit when it is not required.

Automatic Volume Control for Your Command Set

Automatic volume control is extremely effective in preventing distortion or overloading on strong local signals. It is very simple to add a.v.c. to the Command receivers. (Note: A few "ARC" series receivers have a.v.c. incorporated). All the essential a.v.c. components are incorporated in all receivers, but there is

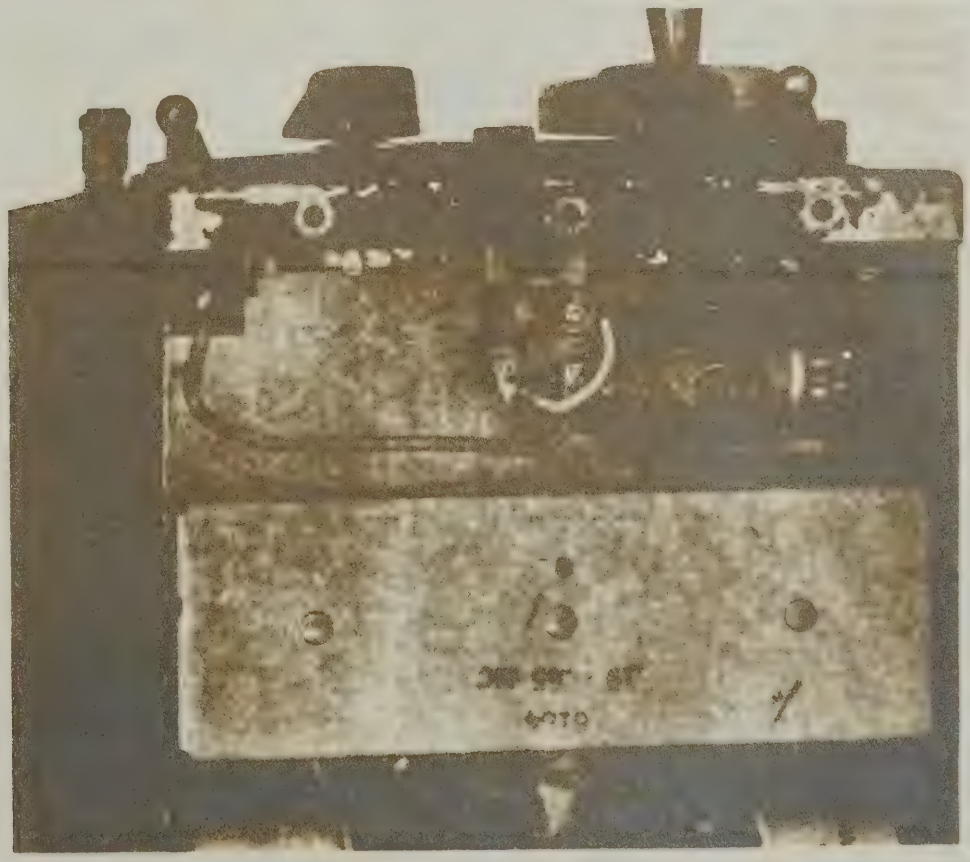
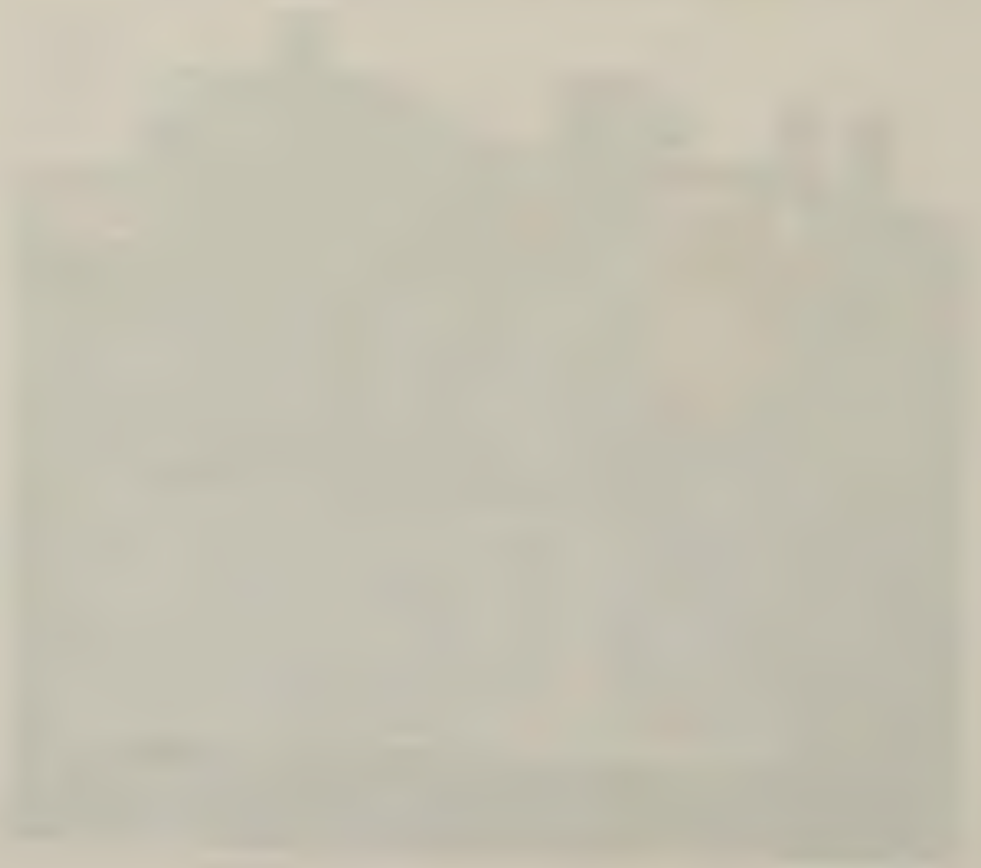


Figure 10
The 12AL5 noise limiter tube may be placed in the underchassis area behind the panel of the receiver.



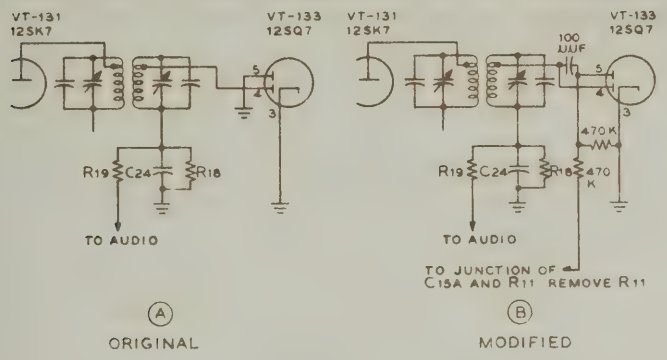


Figure 11
SCHEMATIC, A.V.C. CIRCUIT FOR "COMMAND" RECEIVER.

no connection between them. The purpose of this conversion is to provide a.v.c. action to the r.f. and i.f. amplifier stages by completing the a.v.c. circuit. It requires two additional resistors and a capacitor. Refer to figures 11A and 11B. First, unground pin 5 of the 12SQ7 (VT-133). Connect the 100 μμfd. capacitor across pins 4 and 5 of the tube socket. Connect the 470K resistor from pin 5 to an adjacent ground lug. Connect the second 470K resistor between pin 5 and the junction of C-15A and R-11. Remove R-11 from the circuit to increase the effect of the a.v.c. action.

A Built-in Speaker for Your Command Receiver

A small speaker may be mounted in the removable adapter plate in the front of the Command receiver. The "speaker" is the small receiver element in standard use in telephone handsets. It is only 1½" in diameter, and 11/16" thick. It is available on the surplus market, and identifiable by the letters *HA-1* stamped on the face.

A blank aluminum plate replaces the original adapter plate. A hole is cut in the plate just large enough to clear the HA-1 unit. A second hole is made for the gain control, shown in figure 6.

If the b.f.o. switch is not used, placement of parts on the new plate is not critical. However, if a b.f.o. switch is desired it will be a tight squeeze to get the three components together on the new adapter plate.

A single layer of "Scotch" electrical tape is wrapped around the shell of the speaker to isolate it from

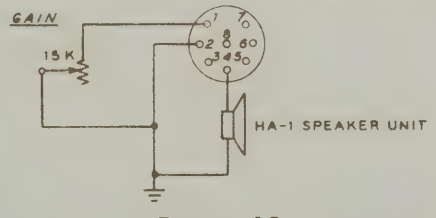


Figure 12
SCHEMATIC, HA-1 SPEAKER FOR USE IN "COMMAND" RECEIVER.

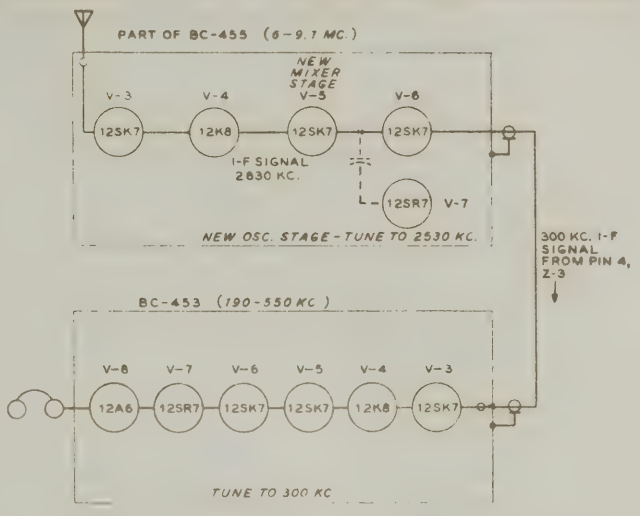


Figure 13
BLOCK DIAGRAM OF DOUBLE-CONVERSION AMATEUR BAND RECEIVER MADE FROM TWO "COMMAND" RECEIVERS. BC-455 serves as r.f. portion, and BC-453 serves as "i.f. strip."

the chassis, and after placing the speaker in the hole in the plate a second piece of tape is wrapped around the body of the speaker to hold the unit from slipping out of the hole.

Wire the positive side of the speaker directly to pin #4 of J-1 (the front plug in the back of the adapter plate). Mount the gain control. Wire the "hot" arm of the control to pin #2 of J-1, and the other side of the control to pin #1 of J-1. Finally, connect the other side of the speaker to ground. Screw the adapter plate to the front of the receiver, and you have a sensitive, clean-sounding speaker, audible many feet from the receiver. The complete wiring changes are shown in figure 12.

A "Double Conversion" Command Receiver for Single Sideband Reception

It is possible to combine two Command receivers to form a double conversion receiver, well suited for single sideband reception or selective c.w. reception. The BC-453 (190–550 kc.) and BC-455 (6–9.1 Mc.) receivers are used. A block diagram of the combination is shown in figure 13. The BC-455 tunes the 7 Mc. amateur band (or it may be modified for other bands as described later) and the intermediate frequency signal of this receiver (2830 kc.) is converted to 300 kc., within the tuning range of the BC453. The combination provides excellent sensitivity, selectivity, and freedom from bothersome "image" signals.

Only a portion of the BC-455 is used. The r.f. amplifier, mixer, and first i.f. stage function in the usual manner, and are unmodified. The second i.f. stage (12SK7) V-5 is changed into a mixer, and the b.f.o. section of the 12SR7 (V-7) is converted to a mixing oscillator. The 12A6 audio tube is removed.

MODIFICATION OF BC-457 TO 80 METERS AND BC-458 TO 40 METERS

The popularity of the SCR-274N series of Aircraft Command Transmitters has resulted in a scarcity of the units, particularly those covering 40 and 80 meters. The intermediate ranges, BC-457 4 to 5.3 Mc. and BC-458 5.3 to 7 Mc. are available from stock and with the following simple modification will operate successfully as either a VFO or transmitter on 80 and 40.

If you do not already have a copy of our article "Conversion of the SCR-274N Transmitters", send 10¢ to cover mailing and handling and we will mail it along to you. This article has a complete circuit diagram, power supply suggestions, and keying hints that will prove helpful.

MODIFICATION OF BC-458 TO 40 METER USE

Method 1 (Note: This method will not operate with the calibrated scale.)

1. Remove oscillator shield can.
2. Loosen the two locking arm set screws from padder condenser shaft, using proper size bristo wrench.
3. Drill a ¼" hole in shield can 9/16" below bottom edge of locking arm access hole.
4. Temporarily replace shield can with several screws, apply voltages to oscillator and adjust large padder section to 7.4 mc (or highest frequency desired - 7.425 mc will take care of the 10 meter band) with dial set at 7.0 mc. This adjustment requires moving condenser shaft several degrees counterclockwise.
5. Remove shield can and tighten locking arm set screws.
6. Replace shield can and securely tighten all screws.
7. Place a milliameter in final amplifier plate lead and adjust amplifier padder for plate current dip.

Method 2

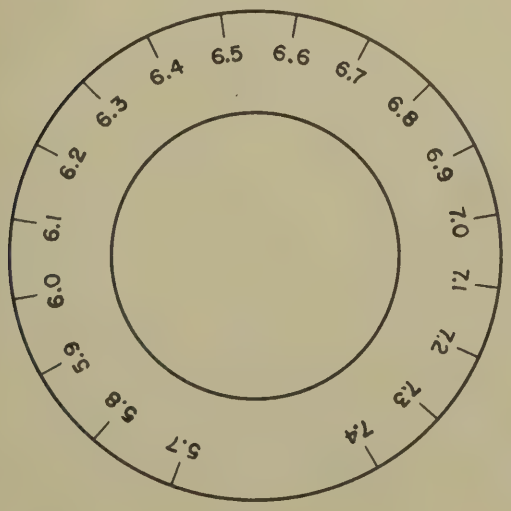
1. Remove shield can and short out 1 turn at top of oscillator coil.
2. Turn iron core to within one turn of completely in.
3. IMPORTANT: Replace oscillator shield can tightly now.
4. Adjust oscillator trimmer for 7.4 mc with the dial set at 7.0.
5. Set dial at 5.8 and trim with iron core until resonance is indicated in the magic eye (6200 kc.).
6. Repeat 4 and 5 several times to insure tracking.
7. Short one turn at top of amplifier tank coil and turn slug to within two turns of completely in.
8. Set dial at 7.0 and tune amplifier padder for plate current dip.
9. Set dial at 5.8 and tune iron core in amplifier tank for current dip.
10. Repeat operation 8 and 9 several times until minimum plate current does not vary more than about 4 ma. from one end of dial to the other.

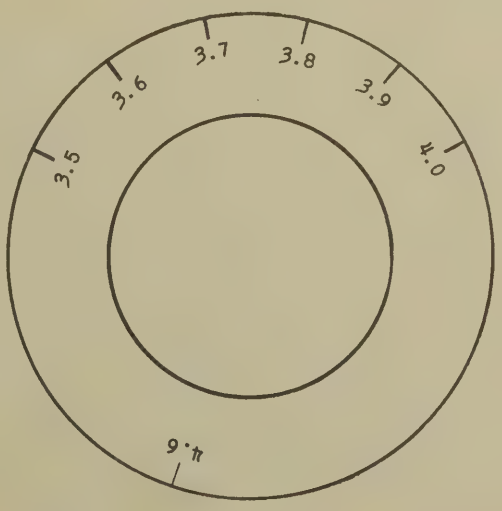
Carefully cut out the chart below and paste it to the dial for calibration of the new range.

MODIFICATION OF BC-457 TO 80 METER USE

1. Remove shield can over oscillator coil.
2. Remove connection at top of coil and add four turns of insulated hook-up wire closely spaced, connecting end of wire to condenser lead.
3. Replace shield can.
4. Set dial to 5.1 and adjust iron core until magic eye indicates resonance at the crystal frequency, 4.6 mc.
5. Set dial to 4.0 and trim to 3.5 mc. with padder condenser.
6. Repeat operation 4 and 5 several times to insure proper tracking.
7. Add 4 turns to top of amplifier tank coil and insert a milliameter in plate supply line.
8. Adjust amplifier padder to resonance as indicated by plate current dip.
9. If amplifier plate current variation exceeds 3 ma. from one end of dial to the other, adjust amplifier padder for minimum variation between 3.5 and 4 mc.

Carefully cut out the calibration chart below and paste it to the dial for calibration of the new range.





LU4PID

Donald L. Stoner, W6TNS
Engineering Consultant
P. O. Box 137
Ontario, California

SURPLUS

A Command Set Six Meter Transceiver

Every so often I really get enthused with a surplus conversion, and this particular unit is one of them. As the expression goes, I have been having a "pigs picnic" operating low power on the Six meter band. The Command Set Transceiver represents one way of getting on this band with a minimum of cost.

We do not hear much about transceivers these days. For the un-initiated, a transceiver is a device that uses part of the receiver while transmitting or vice-versa. In the Command Set Transceiver, the 12A6 audio amplifier is also used as a modulator, hence the term transceiver is applied. This combining of functions simplifies the device without sacrificing performance. The unit was designed so that it may be used as a home station or a mobile rig with equal efficiency.

Why use the Command Set receiver as the basis for the transceiver? Well, you do not really have to, the converter and transmitter could be used in conjunction with the station receiver. However, the Command Set receiver lends itself nicely to this operation without much trouble. As you probably know, the Command Set receivers have been converted to just about everything but an automatic dishwasher and I am willing to concede that someone might even be working on that! Herb Brier wrote an excellent article (CQ, Feb. 1954), The Command Set Roundup, that was intended as a final-final conversion article on this "dying" piece of surplus. Not so, say I. The Command Sets may be down and kicking, but they are not dead yet! A check of the local surplus emporiums showed that each one had both the BC-454 and the BC-455 receivers in stock. Prices ran between four and seven dollars, depending on the condition. Most hams admit that they have one or two tucked away for use someday.

About Six Meters

I was amazed at the activity on Six meters. Morning, noon and night there is always someone to talk with around here. No less amazing are the East coast band openings. One morning about 10 o'clock, the stations started rolling in from Connecticut to Kentucky. It was rough copy at times, but when the QSB peaked the signals really made the speaker rock and roll. Antenna polarization (always good for an argument in Southern California) did not appear to make much difference on the DX stations. Either vertical or horizontal provided about the same signal strength. However, it was a different story on the local stations. Vertical polarization was used, or no Q5 contacts were made

Circuit Description

As stated earlier, the basis for the Six meter transceiver was the BC-454 (3-6 mc) Command Set receiver. This particular unit was used because of the more selective i-f amplifiers and the broader tuning range. With only the three mc bandspread, the 53 to 54 mc portion of the band was lost. However, the author has never heard anything on these frequencies, except Channel 2's sideband and therefore, the missing mc have not been missed.

On receive, the BC-454 acts as a tunable i-f amplifier in conjunction with the International Crystals FCV-1 crystal-controlled converter. An incoming station, on say 50 mc, beats with the 47 mc crystal in the FCV-1 and the resultant frequency of three mc is amplified in the BC-454. When the receiver is tuned to receive four mc, it has the ability to receive a station on 51 mc, and so on. In this manner, the dial of the BC-454 can be calibrated for the Six meter band. Admittedly, the image rejection would be somewhat better if the 6-9.1 mc Command Set receiver (BC-455) had been used. However, the additional selectivity of the lower frequency model more than made up for this slight disadvantage. If you have a BC-455 on hand and wish to use it instead,

W4PID

Donald L. Stoner, W6TNS
Engineering Consultant
P. O. Box 137
Ontario, California

SURPLUS

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the following conversion instructions still apply, but it will be necessary to use a 43 mc crystal in the FCV-1 rather than the 47 mc crystal specified.

On transmit, B plus voltage is removed from all the receiver tubes except the 12A6. It is applied to the FO-6 Six meter oscillator-driver unit and to the screen grid of the 5763 final amplifier. The transmit-receive switch also changes over the antenna to the transmitter and connects the microphone transformer to the grid of the 12A6, converting it to a modulator tube. The final amplifier draws current only when transmitting because its screen voltage is removed while receiving.

Mobile use was contemplated for the Command Set Transceiver and therefore, a noise limiter was added to the original circuit. This noise limiter is novel in that it uses only two components, a 1N34 crystal diode and a single pole, single throw slide switch. These two parts are connected in series from the grid of the audio amplifier to ground, with the cathode end of the 1N34 connected to the grid. Note that the diode is removed on transmit to prevent any audio distortion of the transmitted signal. The limiter appears to be as effective as the usual detector connected arangement and a lot simpler to install. It should be switched out of the circuit when not in use, for as with most limiters, it introduces audio distortion. Incidentally, this circuit may be used to an advantage in the ASB-5 and the BC-645, 420 mc units.

Converting the Command Set

Just so you do not get lost, better get the receiver working first. Wire the filament circuit as shown on page 67. With a little thought, you can find the shortest path to connect the various tubes. Pins 2 and 7 (or 7 and 8 in the case of V7) can be reversed if necessary, but in general the pin numbers shown will provide the most direct path. Locate the wire to the rear socket for the filaments and label it such. Next, clip the wires on the front adapter and remove this assembly, but retain the front plate. Remove the choke, 3 x .5 mfd capacitor, the dynamotor plug and the rear socket. Remove any wires with both ends disconnected as you go along. Drill, file, or punch out the rear socket hole to 1-3/16 inches and install an 8 pin Amphenol male plug. Connect the filament wire to pin 2, the B plus wire to pin 3 and connect a ground wire to pin 1. Locate the wire that comes from pin 6 of V6 and connect it to the junction of R22 and R23. Drill the pillars off the front panel. In the center hole, install a single pole, single throw toggle switch. Drill the right and left holes to ⅜ inch, install a gain control potentiometer in the left hole and the Centralab wafer switch in the right hole. Locate the wire from R1 and R9 and connect it to the center lug of the pot, and ground the right lug. Locate the wire from the junction of R-15 and R-17 and connect it to one lug of the BFO switch (in the center of the front panel). Ground the other lug of the BFO switch. Locate the wire from T-1 and temporarily connect a pair of headphones from it to ground. Locate the wire from C31 that hangs free and connect it to the ungrounded end of the two wire wound resistors (R22 and R23). This is a temporary connection. Apply power from a suitable power supply, such as that shown in *fig 6*. Advancing the gain control should produce a sizzling sound in the phones. If not, make a check of the plate and screen voltages of each tube. Also, feel the tubes to see if they are hot (this will allow you to double check your filament wiring job). Assuming the Command Set receiver works, connect an antenna to the antenna post and see if you can tune in stations on the 75 meter band (or 40 meter band if you have a BC-455). There should be plenty of headphone volume when the gain control is advanced. Switching on the BFO control should put a "whistle" on all the stations. Turning the transmit-receive switch will not do

Right—Schematic diagram and parts list for the Six Meter transceiver. At first glance the conversion may seem quite complicated, but most of the additional components are part of the International printed circuit subassemblies.

Parts List for the 6 Meter Command Set Transceiver

C101—25 mfd., 25 volt electrolytic capacitor.
C102, C104, C105, C108, C109—.001 mfd., 600 volt disc ceramic.
C103—47 mmfd N.P.O. disc ceramic.
C106—15 mmfd variable capacitor (Johnson 15S8).
C107—50 mmfd variable capacitor (Johnson 50S8).
J1—Open circuit headphone jack.
J2—three connector microphone jack.
J3—UHF style antenna connector (Amphenol 83-1R).
J4—Closed circuit headphone jack.
L101—9 turns #20 wire, ¾ inch diameter (Airdux 610).
L201—FCV-1 antenna coil (resonant at 50.5 mc).
L202—FVC-1 mixer coil (resonant at 50.1 mc).
L203—FVC-1 local oscillator coil (resonant at 46 mc).
LS01—FO-6 oscillator coil (resonant at xtal frequency).
L302—FO-6 buffer coil (resonant at xtal frequency).
PL-1—8 pin male connector (Amphenol 86 CP-8).
R101—10K linear taper potentiometer (Centralab B-14).
R102, R103—220 ohm, 1 watt.
R104—22K, ½ watt.
R105—18K, 2 watt.
S101—single pole, single throw toggle switch (Spemco 1135).
S102—4 pole, 2 position rotary switch (Centralab PA-1011).
S103—single pole, single throw slide switch (Carling S60A).
T101—Carbon mike to p. p. grid transformer (Triad A-5X).
V3, V5, V6—12SK7 or 6SK7 for 6 volt operation.
V4—12K8 or 6K8 for 6 volt operation.
V7—12SR7 or 6SR7 for 6 volt operation.
V8—12A6 or 6F6 for 6 volt operation.
V101—5763
V201—6AK5
V202—6J6
V301—6U8
XTAL 1—1N34 crystal diode.
XTAL 2—47.0 mc International Xtals for BC-454 or 43.0 mc for BC-455.
XTAL 3—Crystal cut to 6 meter operating frequency.
Miscellaneous components required: — International FCV-1, 6 meter converter; International FO-6 crystal oscillator unit, 7-45 mmfd rotary trimmer, (see text); 9 pin porcelain tube socket, two 2½ inch metal pillars (see text).

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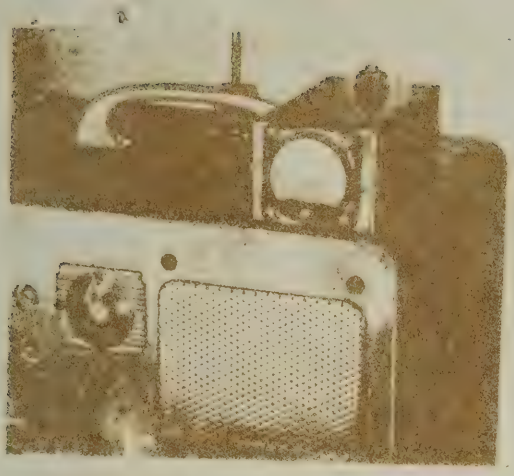


"Operator's eye view" of the plug in "S" meter as attached to a Gonset Communicator. The box is secured to the cabinet by a small screw through the ventilating grill.

Inside view of the plug-in "S" meter. Note the method of mounting the 1" socket on spacers

Front view of the tubeless Communicator V. Note the use of a surplus crystal holder making connections to the crystal socke

tion. There will be more than enough volume for headphones and plenty to operate a speaker. A speaker up to 12 inches may be used by connecting the primary of a standard audio output transformer to a headphone plug. Naturally the secondary is connected to the speaker. The plug is inserted in place of the headphones for speaker operation. A Triad S-12X is an ideal transformer for the job.

The antenna system is up to the individual, as the pi-network will match any impedance from 50 to 300 ohms. Several excellent 6 meter antennas are described in past issues of CQ. I use a ground plane antenna (vertically polarized) that will be described at a later date in the Novice section of CQ.

Since the transceiver draws only 60 milliamperes on receive and 50 mA. on transmit, the *Heath* VP-1 should make an excellent power supply for mobile use. To use the Command Set Transceiver [illegible] it is necessary to replace all 12 volt tubes with their 6 volt equivalents and jumper pins 2 and 7 of the power plug. For 12 volt mobile operation, the original tubes are fine, but it will be necessary to insert a 6 ohm wirewound resistor [illegible] series with pin 7 of the power plug.

[illegible] is for metering the plate current of the 5763 final amplifier during tune up. Under normal antenna loads the plate and grid [illegible] 30 ma. on a 250 volt power supply. Once the initial tuneup has been completed it is not necessary to retune any of the adjustments over any of the positions of the Six meter band.

Letters to the Surplus Editor

Debut [illegible] for the photographs of the Communicator [illegible] month (sob), so [illegible] they are [illegible]. Hope the delay did not [illegible] a nice letter from [illegible] how to receiv[illegible] the same trick [illegible] the Communicator [illegible] crystal [illegible] for the particular [illegible] kc, but I'm not

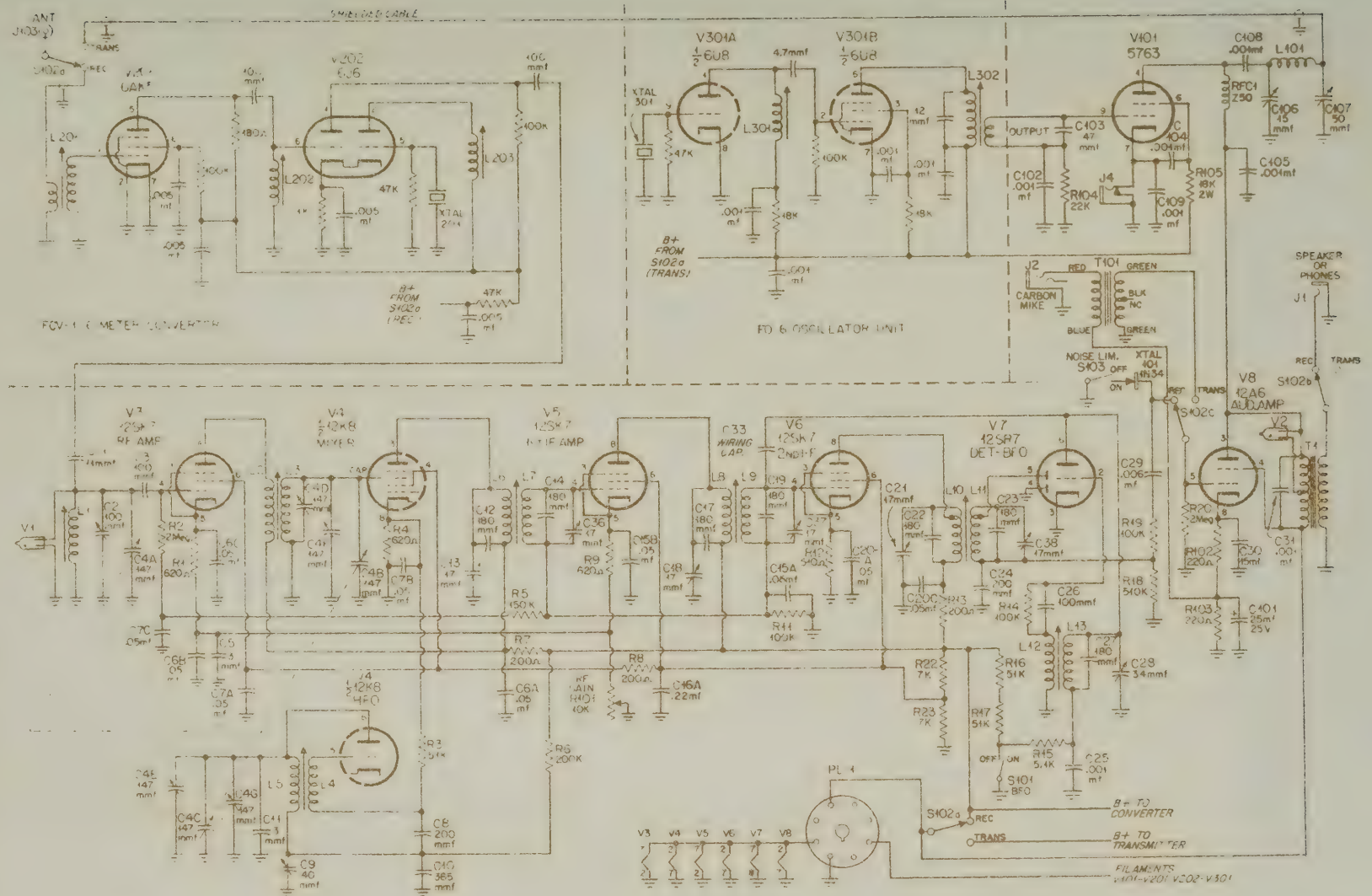
[illegible] I've tried [illegible] 6 meters [illegible] help me? How [illegible] surplus item while [illegible]

Well, [illegible] for one for Jack, so [illegible] might have one for [illegible] surplus salesmen?

W[illegible] NM indirectly sent some con[illegible] the TBY transceiver (Wayne [illegible] Is anybody interested [illegible] this unit?

[illegible] receiver and I thought maybe you [illegible] a National Receiver similar to [illegible] 13 tube receiver and the Model [illegible] need the tube line-up. It tunes

continued on page 106


ANT J103(+)
SHIELDED CABLE
TRANS
S102a REC
V1 6AM6 RF AMP
V2 6U8 1ST MIXER
V3 6U8 2ND MIXER
V4 6U8 HFO
V5 12SK7 1ST IF AMP
V6 12SK7 2ND IF
V7 12SR7 DET-BFO
V8 12A6 AUD AMP
V101 5763
V301A 1/2 6U8
V301B 1/2 6U8
FCV-1 E METER CONVERTER
FD 6 OSCILLATOR UNIT
B+ FROM S102a (TRANS)
B+ FROM S102a (REC)
OUTPUT
CARBON MIKE
RED
GREEN
BLK
NC
BLUE
NOISE LIM. S103
OFF
ON
XTAL 401
SPEAKER OR PHONES
J1
J2
T101
T4
S101 BFO
S102b
S102c
PL-1
B+ TO CONVERTER
B+ TO TRANSMITTER
FILAMENTS V301-V201 V202-V301

40 meters are not recommended f
mobile operation. Their i.f. channels
too high and as a result the receivers tune
broadly for effective mobile operation. The
however, useful as standby or interim equip
ent, and if they can be purchased cheaply
ough make a very satisfactory secondar
receiver.

The low frequency (200-500 kc.) and inte
mediate frequency (520-1500 kc.) receivers mak
very satisfactory r.f. strips for mobile converte
The receivers have high sensitivity and a v
good order of i.f. selectivity. The selectiv
curves for all receivers are shown in *Fig. 5-13*

Six Volt Conversion of the Receivers

To rework the receivers for six volt operation
is relatively simple. The filament circuit may
be rewired as shown in *Fig. 5-13-F* which plac
all the tube heaters in parallel. The tube

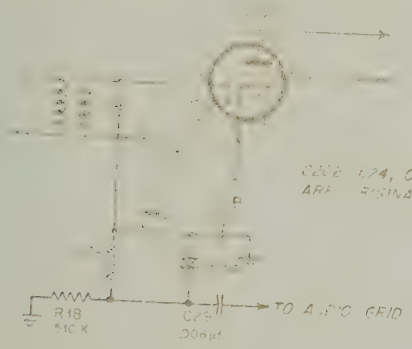


Fig. 5-13-G. This simple but effective noise limiter may be left in the circuit at all times.

but a 6K6 or 6V6 will wor
ute. The 12SF7 tube in th
ivers until recently had n
art, but the 6SF7 is now avai
ed, the filament choke, *L-14*,
om the receiver as it is of
control panel should be mad
ft by the removal of the swit
ts on the front of the receive
el contain a volume control,
speaker jack. The panel
wn in *Fig. 5-13-F*, and the

A. Basic receiver circuit sche
170) and parts list. With the e
coils this is the circuit of
r surplus 274N series receivers

C-28—34 μμfd
C-29—0.006 μfd
C-30—15 μfd.
C-32—5.0 μfd
C-33—wiring c
C-36, C-37, C-38

R-1, R-4, R-9—62
R-2, R-20—2.0
ohm
R-3, R-16, R-17—
51,000 ohms.
R-5—150,000 ohm
R-6—200,000 ohm
R-7, R-8, R-13—20
ohms.
R10—360,000 ohm

R-12—510 ohms.
R-15—5100 ohms.
R-18—510,000 ohm
R-21—1500 ohms.
R-22, R-23—7000

Conversion of the SCR-274N Transmitters for Amateur Band VFO

Price 10c

By D. C. McCoy, W8CBI *

Transmitters from the SCR-274N aircraft radio sets can be readily converted into excellent VFO units for use in the 80, 40 and 20 meter bands. The changes required are simple and well within the constructional ability of the average ham. The BC-696-A, range 3 to 4 m.c. and the BC-459-A, range 6 to 9.1 m.c. are best suited for the job, and retain their original calibration as manufactured. The original circuit, as the units are manufactured, is shown in Figure 1. The BC-459-A can also be converted for output in the 14 m.c. amateur band by simple changes. The exact procedure for conversion will depend on individual needs. Suitable variations from procedures outlined herein can be readily worked out by the individual application of the customary ham ingenuity.

To secure a unit which will permit "break in" C.W. operation requires proper alteration to solve the following problems present in the units when used as wired by the manufacturer:

1. Relays will not operate on A.C.
2. When keyed a back wave 10 to 20 KC higher than operating frequency is encountered with the key open.
3. The note produced is chirpy and yoops.
4. The frequency checking system does not function well with A.C. on the filaments.

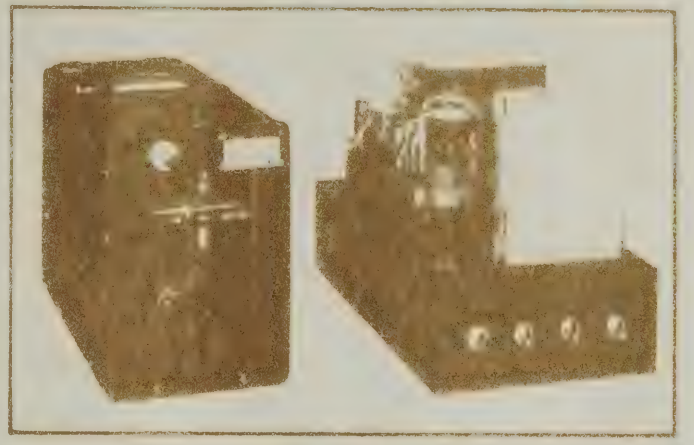
At W8CBI the following features were desired in the converted products

1. An assembly of three VFO's covering the 80, 40 and 20 meter amateur bands, operated from a common power supply with band switching, meter switching, and meters included in the power supply.
2. Ability to spot frequency without "swishing" station signal across the band and annoying other amateurs while changing frequency.
3. Clean keying and a good note for "break in" C.W. operation.
4. Output to drive an RK-20 Puffer-doubler which in turn drives a 1 K.W. final, the RK-20 being link coupled to the VFO by 100 feet of 72 ohm line due to the remote location of the RK-20 and final.

Filaments

Operation of filaments on 24 to 28 volts A.C., as connected for 24 volts D.C. was chosen, as a transformer with 26 volts output and ample current rating was available. Operation of filaments on 12 volt A.C. can be readily obtained by changing the filament connections to all tubes in parallel. Changes required are obvious from Figure 1. Use of the 24 volt A.C. filament operation also solves part of the keying problem as will be seen later; consequently it is recommended.

* R.R. #7, Dayton 9, Ohio



Coupling

With link coupling to the following stage the antenna tuning coil L-52 and antenna relay K-54 are not needed. These are therefore completely removed. To make connection of the link to the following stage, the antenna binding post was removed and a National FWJ two-post terminal was installed on the front panel. A National FWF plug carrying the line to the next stage can then be plugged in. Disconnect the grounded end of the coupling coil T-54-B. Connect both ends of the coupling coil to the FWJ terminals with a twisted pair line or a short length of Amphenol 72 ohm line. Coupling of T-54-B can now be adjusted to the proper drive on the following stage by "Antenna Coupling" knob on the front panel.

Keying

Relay K-53 is used as a keying relay. The plate of the oscillator and the cathodes of the amplifiers are keyed simultaneously with the relay. Since this relay will not operate on A.C. a selenium rectifier with suitable filter is incorporated in the power supply and provides 24 volts D.C. for proper operation of the relay. See Figure 2 for details of the rectifier and filter system. The relay may be removed from the VFO unit and installed in the power supply with good results. Installation in the power supply removes the possibility of the relay shaking the elements of the oscillator tube. Figure 2 shows power supply wiring with relay installed in VFO. The necessary circuit changes are readily substituted if installed in power supply.

Clean keying is accomplished by a combination of regulated voltage to the oscillator plate and use of an R.F. choke in the plate circuit of the oscillator. Install a 2.5 mh choke between pin No. 3 on the 1626 tube V-54 and the filter resistor R-68. This should be installed as close to the socket as possible. Regulated voltage at 210 volts is furnished for the oscillator plate.

Back wave from the amplifiers when the key is open is eliminated by installation of a .002 mica, 1000 volt bypass condenser from Pin 6 of tube V-56 to the ground. Make this connection as short as possible.

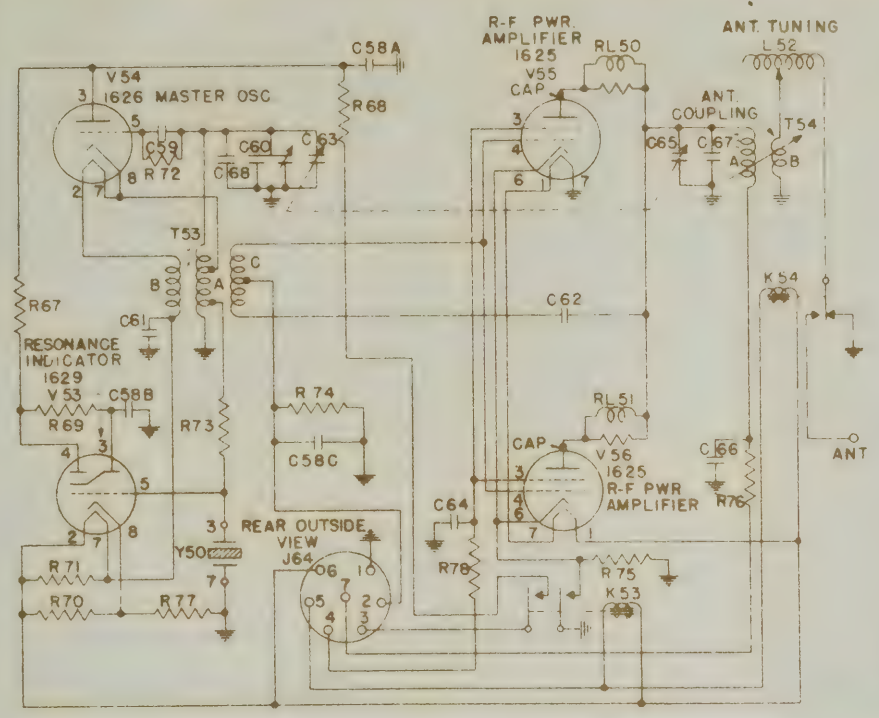


FIGURE 1

TYPICAL SCR-274N TRANSMITTER

BC-696-A 3 - 4 MC *
BC-457-A 4 - 5.3 MC #
BC-458-A 5.3 - 7 MC £
BC-459-A 7 - 9.1 MC @

CAPACITORS			RESISTORS		
Symbol	Microfarads		Symbol	Ohms	
C 58	ABC .05/.05/.05		R 67	51,000	
C 59	.00018		R 68	20	
C 60	M.O. Padding		R 69	1 Meg.	
C 61	.006		R 70	1000	*
C 62	Fixed Neutr.		R 70	1000	#
C 63	M.O. Tuning		R 70	1500	£
C 64	.002		R 70	1500	@
C 65	P.A. Tuning		R 71	126	
C 66	.01		R 72	51,000	
C 67	P.A. Padding		R 73	10,000	*
C 68	.000003		R 73	15,000	#
TRANSFORMERS			R 73	5100	£
			R [illegible]	5100	@
T 53	Master Osc.		R 74	15,000	
T 54	Power Amp.		R [illegible]	51,000	
MISCELLANEOUS			R [illegible]	20	
			R [illegible]	390	
L 52	Ant. Inductor		R 78	51	
RL 50	Parasitic Sup.		RELAYS		
RL 51	Parasitic Sup.				
Y 50	Crystal Unit		K 53	Keying	
			K 54	Antenna	

The next step is to rewire the K-53 relay coil circuit. Disconnect the wire from the relay coil which connects it to Pin 6 on the power input socket J-64. Connect this end of the relay coil to the chassis as ground. Be sure that the line between Pin 6 on J-64 and Pin 1 on V-56 is retained as the 1625 filaments will not light if this connection is broken. The other end of the relay coil is already connected to Pin 5 on J-64 and is left as is. The keying circuit to the power supply is thus completed through Pin 5 and Pin 1 on J-64 and thru the key jack into the rectifier-filter system in the power supply.

Calibration Circuit

As the units were originally designed for operation on 24 volts D.C., the 1629 tube gets part of its bias from the D.C. filament voltage. Therefore when operated with A.C. on filaments this bias is not available. To supply proper bias to this tube, remove resistors R-70 and R-77 from V-53. Replace R-77 with a 2000 or 2500 ohm one-watt resistor. Tuning calibration will now be sharp and clean, retaining one of the desirable features of these transmitters.

Calibration of these units is accomplished as follows:

1. Open rear hinged cover over the 1629 and 1626 tubes. A small mirror is on the under side of the cover above the 1629, for use in case it is not convenient to look directly down into the cabinet.
2. Set VFO dial to frequency of crystal in unit. The BC-696-A has a 3500 KC crystal, BC-458-A a 6200 KC crystal, and BC-459-A a 8000 KC crystal.
3. Apply oscillator voltage and close key. The shadow in the 1629 tube should open to a wide angle.
4. Open the snap slide in front of the 1629 tube and insert screw driver. Adjust oscillator trimmer with screw driver for maximum shadow on 1629 tube. Clockwise rotation of trimmer lowers frequency.

Power Socket and Cable

As is usual with most "surplus" equipment, power supply cables and plugs are rarely available. The power supply socket J-64 can be replaced with a male 7-prong plug such as Amphenol 86-CP7 with retainer ring and mounting plate. Connections to the pins remain the same. A 6-prong plug can be used, in which case the connection to Pin 2 on J-64 should be eliminated. This connection is provided to insert a milliammeter to measure the grid current on the 1625 amplifiers. Using the 7-prong connection, following is the line-up of connections and the colors of wiring inside the chassis:

Pin 1. Tube filaments, cold side; minus plate voltages for oscillator and amplifiers; minus D.C. to keying relay and chassis of VFO. Black.
Pin 2. For insertion of meter to read amplifier grid current. Black.
Pin 3. Plus 210 volts for oscillator. Red.
Pin 4. Plus screen voltage for amplifiers. Yellow.
Pin 5. Positive low voltage D.C. for keying relay coil. Black.
Pin 6. Tube filaments, hot side. White.
Pin 7. Plus high voltage for plates of amplifiers. Red with white tracer.

A female 6 or 7-prong socket with cord should be provided for connection to the power supply unit.

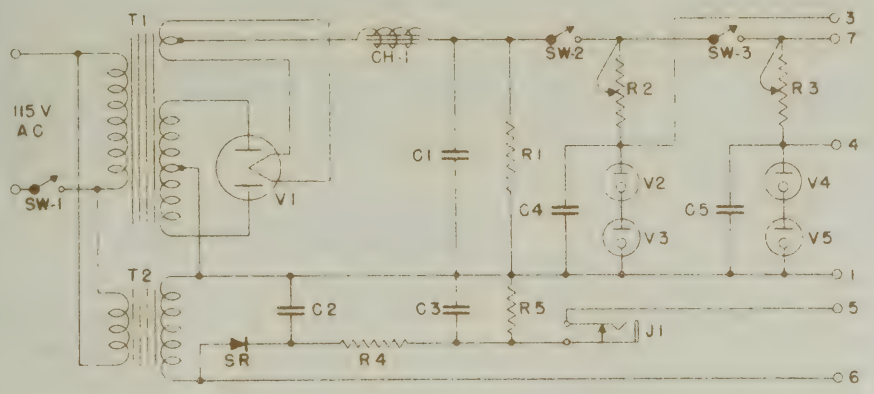


FIGURE 2

VOLTAGE REGULATED POWER SUPPLY

T-1	POWER TRANSFORMER 400 OR MORE VOLTS D.C. OUTPUT AT 200 MA., 5 VOLTS AT 3 AMPS.
T-2	24 TO 28 VOLT FILAMENT TRANS.
CH-1	200 MA. SWINGING CHOKE
C-1	10 MFD 600 VOLT
C-2	25 MFD 50 VOLT
C-3	25 MFD 50 VOLT
C-4	4 MFD 450 VOLT
C-5	4 MFD 450 VOLT
R-1	50,000 OHM 20 WATT
R-2	10,000 OHM 50 WATT W/SLIDER
R-3	10,000 OHM 50 WATT W/SLIDER
R-4	50 OHM 10 WATT
R-5	750 OHM 10 WATT
SR	100 MA. SELENIUM RECTIFIER
J-1	CLOSED CIRCUIT JACK FOR KEY
SW-1 TO 3	SPST TOGGLE SWITCH
V-1	RECTIFIER TUBE 5Z3 OR 83
V-2	VR-105 VOLTAGE REGULATOR TUBE
V-3	VR-105 VOLTAGE REGULATOR TUBE
V-4	VR-105 VOLTAGE REGULATOR TUBE
V-5	VR-150 VOLTAGE REGULATOR TUBE

NOTE: TO ADJUST R-2, OPEN GROUND LEAD FROM V-3, INSERT 100 MA. METER AND MOVE SLIDER UNTIL 25 TO 30 MA. SHOWS ON METER WITH NO LOAD ON THE CIRCUIT. REMOVE METER AFTER ADJUSTMENT AND RECONNECT GROUND LEAD. ADJUST R-3 FOLLOWING SIMILAR PROCEDURE.

Power Supply

To give good regulation of voltages, a plate transformer with a capacity of 200 m.a. should be used. Use a seperate divider circuit for the screens as shown in Figure 2.

Figure 2 shows correct values of components for 800 volts on amplifier plates, 210 volts on oscillator plates and approximately 250 volts on the screens of the 1625's under load. Band and meter switching refinements incorporated in the power supply at W8CBI have been eliminated for simplicity. A large main filter condenser with swinging choke is used to help voltage regulation when keyed. R-1 (Fig. 2) is a safety bleeder to protect the filter condensers when load is removed from the power supply and transmitter is on "stand-by".

SW-1 connects the 110 volt A.C. to the power supply. SW-2, when closed with SW-3 open, allows frequency to be set without "swishing" the signal and interfering with other stations. Closing SW-3 applies both plate and screen voltage to the 1625 amplifiers and the unit is ready to drive the rest of the transmitter. Screen voltage is secured from the bleeder network R-3, V4, V5 and C5. Since SW-3 applies both plate and screen voltage simultaneously, possible damage to 1625 tubes, due to screen voltage being applied without plate voltage, is eliminated. Once frequency is set, use SW-2 as standby switch with SW-3 remaining closed.

Regulated voltage for the oscillator plate is obtained from the R-2, C-4, V-2 and V-3 circuit. Two VR105 tubes will give 210 volts. See notes on Figure 2 for proper adjustment of this voltage regulating circuit. Properly adjusted, this will regulate the oscillator voltage to within one or two volts when keyed.

Low voltage D.C. for the keying relay coil is obtained from the selenium rectifier and filter circuit SR, R-5, R-6, C-2 and C-3. A closed circuit jack J-1 allows plugging in of a key or bug for C.W. operation. If key plug is removed, the jack closes and carrier is continuous for phone operation.

Converting BC-459-A to 14 MC.

The BC-459-A is converted for 14 Mc. output by changing the 1625 amplifiers to a push-push doubler circuit. All changes previously covered should be made first. Then disconnect the neutralizing condenser C-62 (Fig. 1) from the amplifier grid coil T-53-C at the pin on the coil below the chassis. Next, disconnect C-62 from the plates of V-55 and V-56. Disconnect the grid of V-56 from the grid of V-55. Connect the grid of V-56 to the pin on grid coil from which C-62 has been removed.

Short out the three top turns of amplifier plate coil T-54-A. Loosen shaft locks on rotors of amplifier tuning and padding condensers, C-65 and C-67. Set tuning dial for 7100 K.C. Mesh plates of tuning condenser C-65 one-quarter way in. Relock shaft of C-65 to drive mechanism. Set tuning dial to 8000 K.C. and check calibration of oscillator without plate voltage on the 1625's. Insert a 200 ma. or higher meter in the plate supply line to plates of the 1625's. Reset dial to 7100 K.C. Apply plate voltage to 1625's and set plates of padder condenser C-67 for maximum dip of the milliammeter, using a screw driver to turn the shaft through the plugged opening on the right side of the chassis (looking at front of unit). Remove plate voltages, relock padder condenser, and remove the milliameter. The unit will deliver good output in the 14 m.c. amateur band; output frequency will be double the frequency shown by dial setting.

Optional Keying Method

Since the original of this write-up was made experiments have been conducted with excellent results, keying the oscillator plate and the screens of the 1625 amplifiers, rather than the cathodes of these latter tubes. Remove the cathode resistor R-75 and replace with a 200 to 400 ohm, 20 w. or heavier resistor. Disconnect the cathode and ground contacts on keying relay K-53 from cathode and ground. Open the line between filter resistor

R-78 and Pin 4 on J-64 and insert a 2.5 mh choke between the resistor R-78 and the contacts of relay K-53 which are now connected between this choke and Pin 4. The relay will now have to be insulated from the chassis, or better yet, remove relay from chassis completely and install in the power supply, opening lines from Pins 4 and 3 in the power supply and wiring direct in the VFO chassis from R-68 to Pin 3 of J-64.

Acknowledgement

Acknowledgement is made to W8VMJ, W8OVL and to W3VL for their contributions to this work. Also to numerous hams whose calls were not noted but whose conversations over the air while "snooping" here at W8CBI have contributed to the experimental work making this write-up possible.

The conversion of these fine little units for use as VFO's by the amateur fraternity is a simple process, well within the abilities of the average ham. The wiring of the units is straightforward, clean and simple. The converted units make excellent VFO's with calibration sufficiently accurate for amateur use if converted and operated as outlined herein. With 500 volts applied to the plates of the amplifiers they also make an excellent low power transmitter, connected directly to a suitable doublet antenna, or to any other antenna through a suitable coupling system.

We at Srepco are pleased to have the opportunity of presenting this article by W8CBI. Dan is one of the real old-timers - having been in the game for some 40 years. You'll find him on most all bands at some time or other but he spends most of his time on 40 and 80 CW handling traffic. His QTH is R.R. #7, Dayton 9, Ohio.

The SCR-274N Transmitters are one of the top surplus buys and will give you plenty of watts per dollar invested. The popularity of these transmitters has resulted in a scarcity of the 40 and 80 meter units, BC-459A and BC-696A respectively. The intermediate ranges BC-457A 4 to 5.3 Mc and BC-458A 5.3 to 7 Mc, are available from stock and can easily be modified for 80 and 40 meters. Our BC-457/458 Conversion Sheet with calibrated paper scales is free on request.

When modified to cover 5.7 to 7.4 Mc the BC-458 makes an excellent 40 meter transmitter or a VFO driver for the following bands:

Band	Frequency Setting
6 Meters	6250 - 6750 Kc. (x 8)
10 Meters	7000 - 7425 Kc. (x 4)
11 Meters	6790 - 6857 Kc. (x 4)
15 Meters	7000 - 7150 Kc. (x 3)
20 Meters	7000 - 7200 Kc. (x 2)

The following SCR-274N Components are available from stock:

	TRANSMITTERS	
BC-457	4 - 5.3 Mc. - Used	$4.95
BC-458	5.3 - 7 Mc. - Used	4.95
BC-458	5.3 - 7 Mc. - Brand New	5.95
	RECEIVERS WITH DYNAMOTOR	
BC-453	190 - 550 Kc. - Used	$6.95
BC-454	3 - 6 Mc. - Used	5.95
BC-455	6 - 9.1 Mc. - Used	5.95
	MODULATORS	
BC-456	Used with DM33 Dynamotor and Plugs	$2.95
	RACKS, ETC. (Used with Plugs)	
FT-220	3-Section Receiver Rack	$1.95
FT-226	2-Section Transmitter Rack	1.95
BC-450	3-Receiver Control Box	.98
BC-451	Transmitter Control Box	.49
BC-442	Antenna Relay Unit with RF Current Meter and 50 MMFD Vacuum Condenser	1.95

ALL THE USED ITEMS ARE IN GOOD CONDITION AND WILL BE GUARANTEED TO BE SATISFACTORY TO YOU - YOU BE THE SOLE JUDGE IF THEY ARE NOT A REAL BARGAIN.

Filament Transformers for the SCR-274N Receivers $1.95
C-45, 24 Volt ½ Amp. **C-84**, 12 Volt 1 Amp.

POWER SUPPLY PARTS LIST

		Net Price
T-2	Staco 5005 Filament Transformer - Two Secondaries each 12 volts at 3 amps.	$4.35
T-1	UTC S-41 Power Transformer, 600-0-600V 200 MA., 5V 3A, 6.3VCT 2A, 7.5V 3A tapped at 6.3V. Gray Case.	9.50
	or Stancor P-6170 Power Transformer 600-0-600V 200 MA., 5V 3A, 6.3 VCT 6.3 VCT 4A. Black Case	7.29
CH-1	UTC S-32 Swinging Choke 5-25 HY 225 MA. Gray Case.	5.00
	or Stancor C-1402 Swinging Choke 4-6 HY 250 MA., Black Case.	4.02
C-1	Stock No. B-612 - 10 MFD 600 VDC G. E. Pyranol Filter Condenser	1.49
C-2	25 MFD 50 Volt Electrolytic Condenser	.54
C-3	Same as C-2	.54
C-4	4 MFD 450 Volt Electrolytic Condenser	.54
C-5	Same as C-4	.54
R-1	Ohmite 50,000 ohm 20 watt Resistor	.75
R-2	Ohmite 10,000 ohm 50 watt Resistor w/slider	1.32
R-3	Ohmite 10,000 ohm 50 watt Resistor w/slider	1.32
R-4	Ohmite 50 ohm 10 watt Resistor	.35
R-5	Ohmite 750 ohm 10 watt Resistor	.35
SR	Sylvania NC-5 100 MA. 5 Plate Selenium Rect.	.96
J-1	Stock No. C-341 Closed Circuit Jack	.33
SW-1 to 3	SPST Toggle Switch, Each	.27
V-1	5R4GY Rectifier Tube (for 500-600V supply)	1.30
	5Z3 (for 400-500V supply)	.90
V-2 to V-4	VR-105 Voltage Regulator Tube	1.20
V-5	VR-150 Voltage Regulator Tube (Surplus)	.69
	Octal Sockets (4 or 5 required), Each	.11
	4 Prong Socket (for 5Z3)	.09
	Amphenol RS-7S 7 Prong Socket	.09
	Amphenol PM-7S 7 Prong Plug	.19
	Chassis 7" x 12" x 3" CB-792 Black Crackle Finish or CB-793 Electro Zinc Finish	1.05

MODIFICATION PARTS LIST

National FWJ - 2 Jack Terminal	.45
National FWF - 2 Terminal Plug	.66
(Or use the existing binding post and install another beside it.)	
Binding Post and Feed-Thru Insulator	.29
2.5 MH RF Choke 100 MA.	.30
2700 ohm 1 watt Resistor	.10
.002 MFD 1200 Volt DCW Mica Capacitor	1.14
Amphenol CP7S 7 Prong Plug with Mounting Ring and Plate	.19
Amphenol PF7S 7 Prong Cable Connector	.19

USE **B-785 Brass Spline** FOR TUNING SCR-274N RECEIVERS. FITS GEARED SHAFT OF TUNING CONDENSER. 7/32" DIA. SHAFT TAKES CRANK OR KNOB WITH ¼" HOLE. **Only 9¢ each**

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115 E. SECOND ST. DAYTON 2, OHIO

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CABLE ADDRESS: SREPCO

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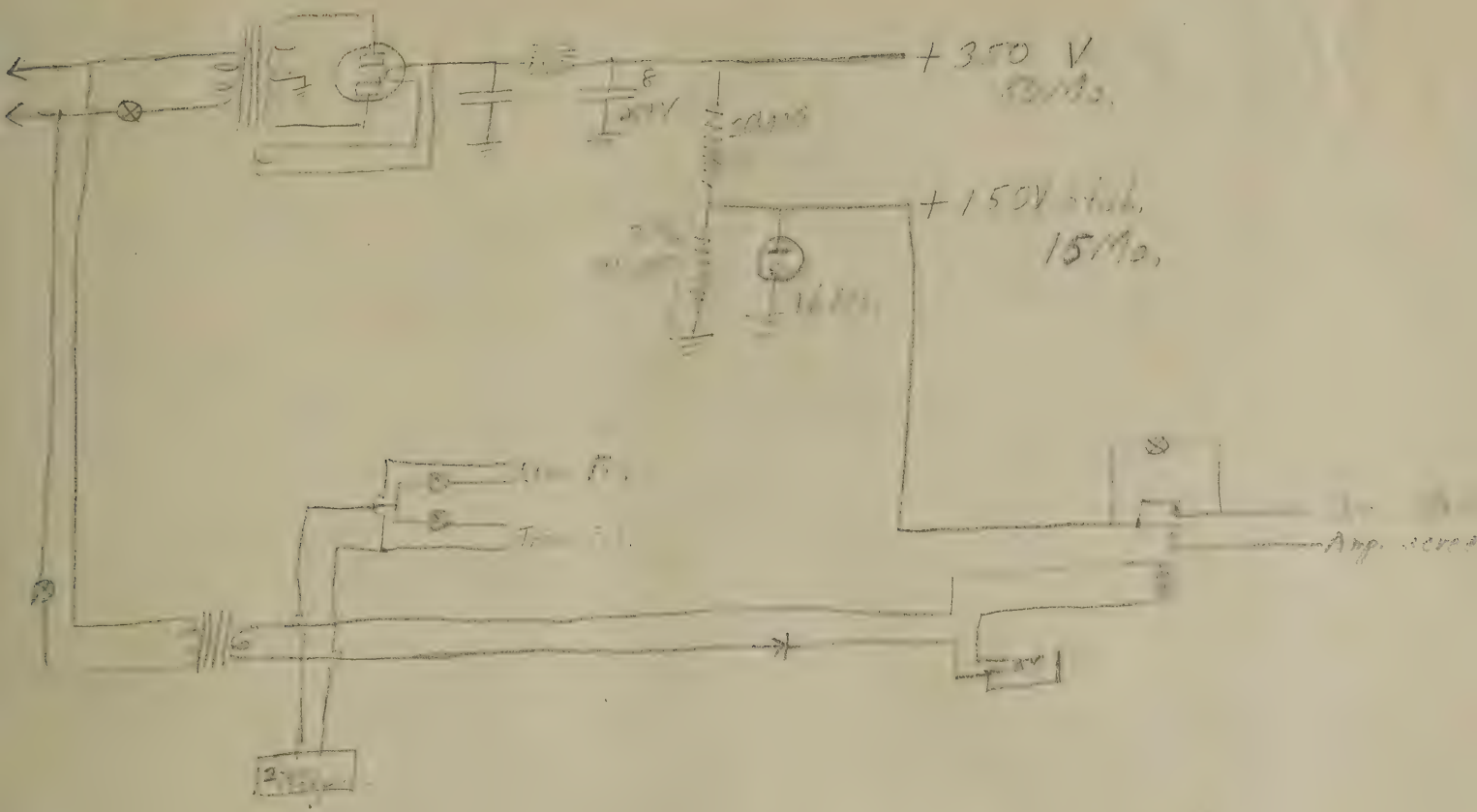
Power Supply for BC 457 A



Power supply as hooked up here actually delivers 440 volts filtered D.C.

$I = \frac{E}{R} = \frac{330}{20,000} = .015 = 15\,mA$

$\frac{1}{20,000} + \frac{1}{15,000} = \frac{1}{x}$ ... With 20,000 Ω

60,000 Ω

If shorted with 15,000 Ω

$\frac{330}{8.57} = 34\,mA$

If shorted with 5,000 Ω:

$\frac{1}{5000} + \frac{1}{15,000} = \frac{1}{x}$

$5x + 1x = 15,000$

$6x = 15,000$

$x = 11,100\,\Omega$

$\frac{330}{11,25} = 27\,mA$

If shorted with 10,000 Ω:

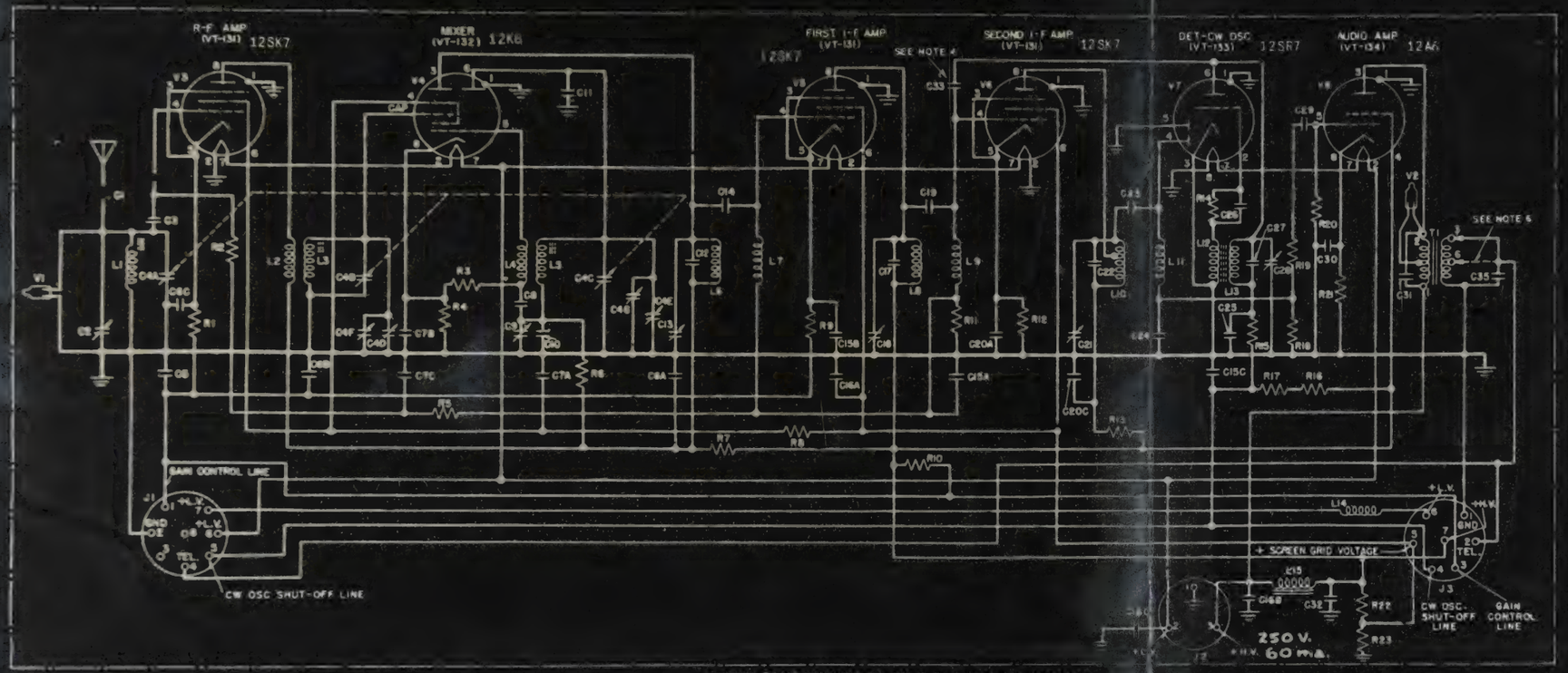
$\frac{1}{10,000} + \frac{1}{15,000} = \frac{1}{x}$

$3x + 2x = 60,000$

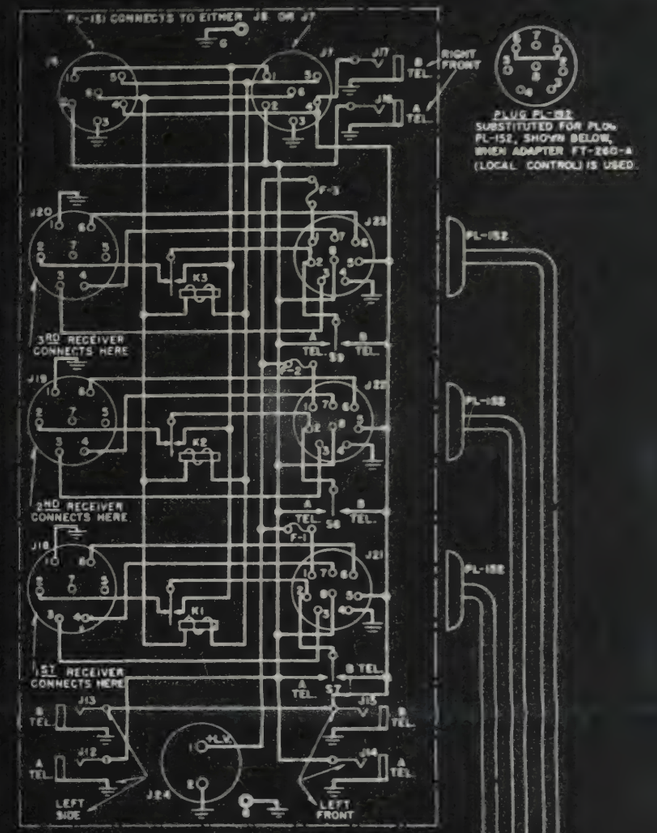
$5x = 60,000$

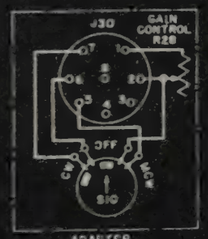
$x = 12,000\,\Omega$

$\frac{330}{12,000} = .025\,A$



TYPICAL RADIO RECEIVER BC-455-B (6-9 MC) I-F-2830KC





NOTES:

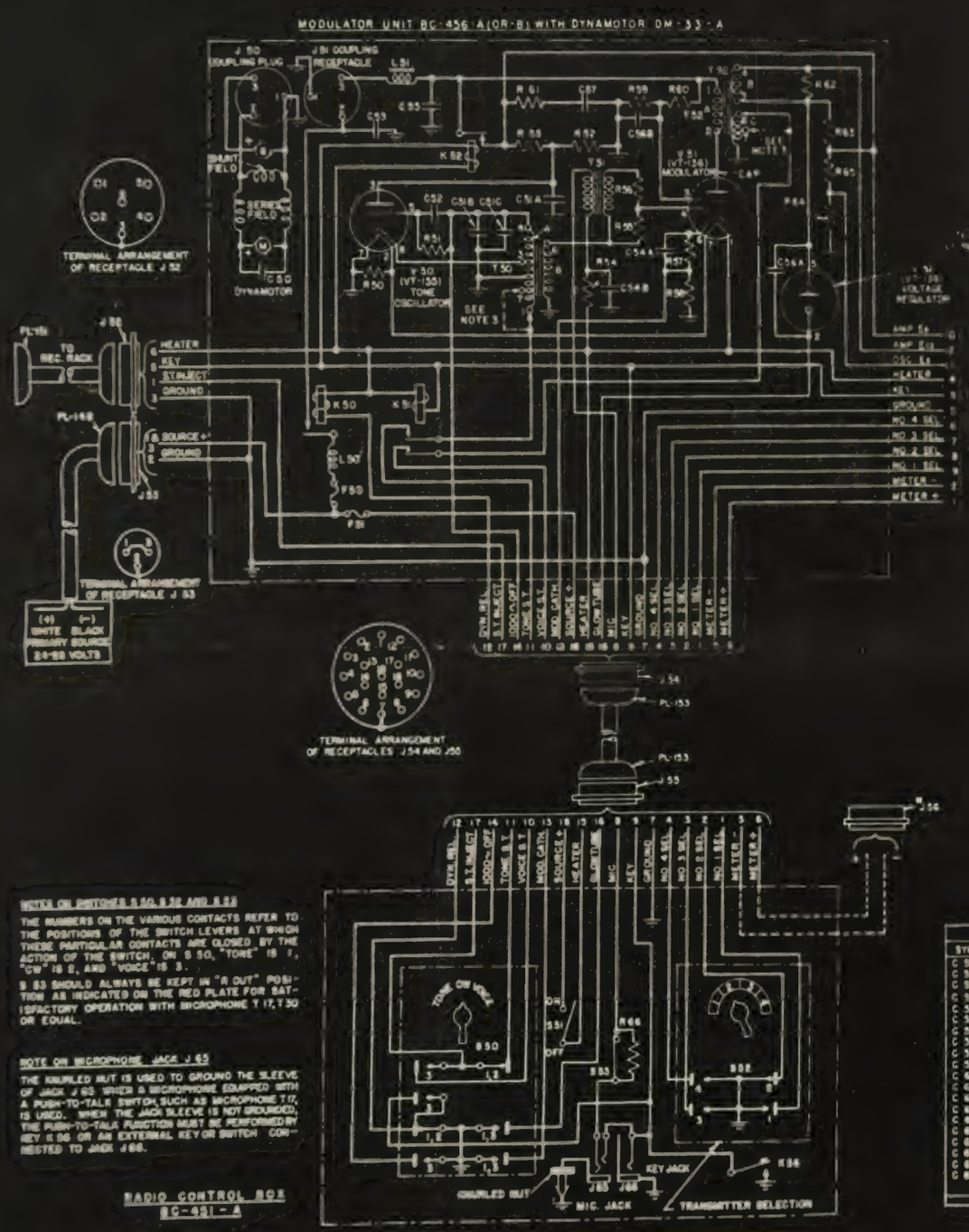
1. CAPACITOR ABBREVIATIONS
   MMF - MICROMICROFARADS
   MF - MICROFARADS
2. ALL PLUGS AND RECEPTACLES ARE SHOWN AS VIEWED FROM THE OUTSIDE
3. ALL RELAYS ARE SHOWN IN THE NON-ENERGIZED POSITION
4. THE CAPACITANCE BETWEEN PIN PLUGS IN THE 2ND I-F RECEPTACLE CONSTITUTES C-33
5. TERMINAL NUMBERS APPEARING ON RECEPTACLES OR JACKS IN RECEIVERS AND ADAPTERS AND ALL CIRCUIT SYMBOLS ARE FOR REFERENCE PURPOSES ONLY. THEY DO NOT APPEAR ON THE EQUIPMENT.
6. TRANSFORMER T1 IN BC-453-B, BC-454-B AND BC-455-B RECEIVERS IS PROVIDED WITH A TAP (TERM 6) FOR LOW IMPEDANCE HEADSETS. THESE THREE RECEIVERS AND RADIO RECEIVERS BC-453-A, BC-454-A AND BC-455-A ARE NORMALLY FURNISHED WITH CONNECTION SHOWN IN SOLID LINES FOR USE WITH HIGH IMPEDANCE (6000 OHMS) HEADSETS. RADIO RECEIVERS BC-453-B, BC-454-B, AND BC-455-B CAN BE CHANGED FOR USE WITH LOW IMPEDANCE HEADSETS BY REMOVING THE TWO WIRES ON TERMINAL 3 AND CONNECTING THEM TO TERMINAL 6 AS SHOWN IN DASHED LINES. SEE FIG. 39.

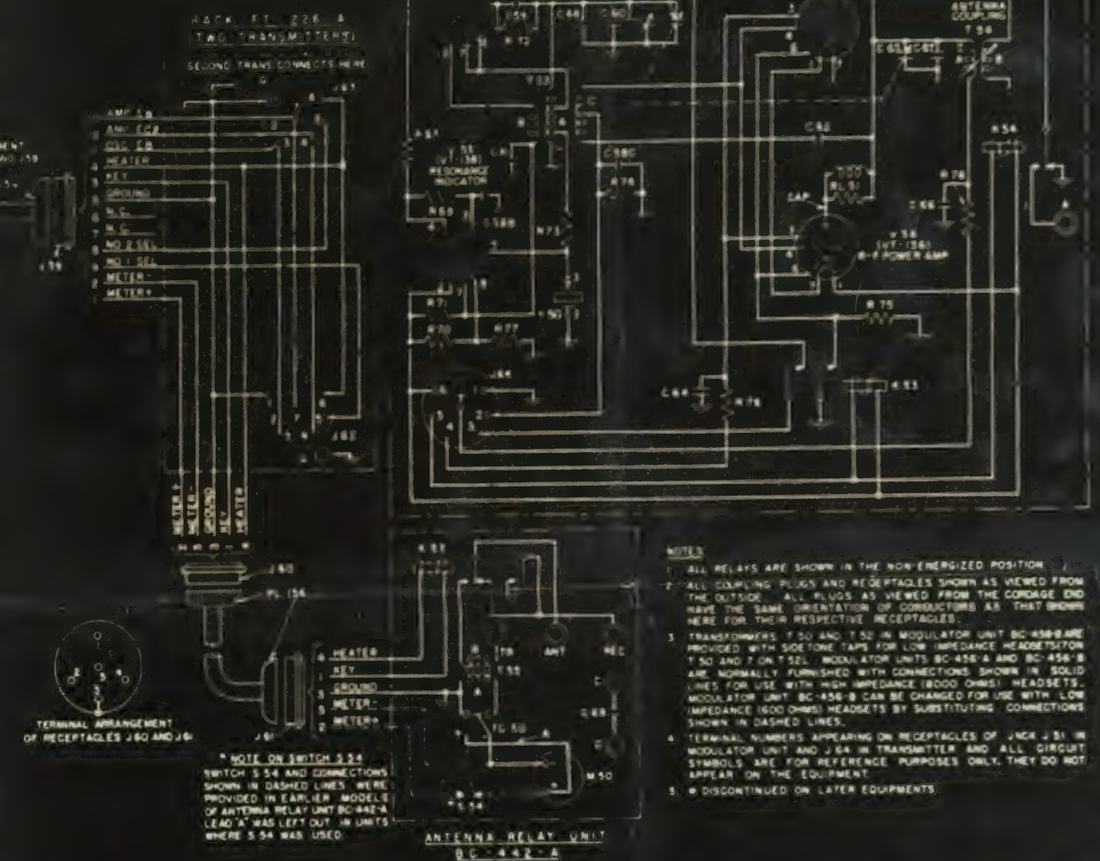
CAPACITORS						INDUCTORS		RESISTORS				MISCELLANEOUS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS	SYMBOL	OHMS	SYMBOL	DESCRIPTION
* C-1	8.5 MMF	C-15(ABC)	.05/.05/.05MF	C-29	.006MF	L-1	ANT INPUT	R-1	620	* R-15	5,100	T-1	OUTPUT TRANSFORMER
C-2	15 MMF	C-16(ABC)	.22/.22/.22MF	C-30	.15MF	L-2, L-3	RF AMP	R-2	2,000,000	* R-16	51,000		
C-3	100MMF	C-17	120 MMF	C-31	.001MF	L-4, L-5	RF OSC	R-3	51,000	* R-17	51,000	V-1, V-2	NEON TUBES
C-4(A TO E)	GANG .62 MMF	C-18	17MMF	C-32	.5 MF	L-6, L-7	IN 1ST I-F	R-4	620	R-18	510,000	K-1, K-2, K-3	REC OUTPUT TRANS SIDE TONE RELAYS
C-5	3MF	C-19	180MMF	* C-33	LESS THAN 2 MMF	L-8, L-9	IN 2ND I-F	R-5	150,000	R-19	100,000		
C-6(ABC)	.05/.05/.05MF	C-20(ABC)	.05/.01/.05MF			L-10, L-11	IN 3RD I-F	* R-6	150,000	R-20	2,000,000		
C-7(ABC)	.05/.05/.05MF	C-21	17 MMF	C-34	.001MF	L-12, L-13	CW OSC	R-7	200	R-21	1,500	F-1, F-2, F-3	10 AMP FUSES
C-8	200 MMF	C-22	180MMF	C-35	750MMF	L-14	RF CHOKE 112 μH	R-8	200	R-22	7,000		
C-9	40 MMF	C-23	180MMF					R-9	620	R-23	7,000		
* C-10	240MMF	C-24	200MMF			L-15	AF CHOKE 3H	R-10	360,000				
C-11	5MMF	C-25	.001MF					R-11	100,000	R-25	0-50,000		
C-12	180MMF	* C-26	100MMF					R-12	510	R-26	0-50,000		
C-13	17MMF	* C-27	165 MMF					R-13	200	R-27	0-50,000		
C-14	180MMF	C-28	56MMF					* R-14	100,000	R-28	0-50,000		

* VALUES SHOWN WITH AN ASTERISK VARY WITH THE RADIO RECEIVER. THOSE SHOWN IN THIS TABLE APPLY TO RADIO RECEIVER BC-455-B (6-9 MC) ONLY. ADDITIONAL CIRCUIT ELEMENTS WHICH MAY BE REQUIRED IN THE OTHER RADIO RECEIVERS ARE NOT SHOWN IN THE TABLE OR IN THE ABOVE SCHEMATIC CIRCUIT OF RADIO RECEIVER BC-455-B.

TYPICAL SCR-274N RECEIVER DIAGRAM

LONG ISLAND RADIO CO.
36-23 164th ST., FLUSHING, L. I., N. Y.
FLUSHING 9-3918


MODULATOR UNIT BC-456-A(OR-B) WITH DYNAMOTOR DM-33-A
TERMINAL ARRANGEMENT OF RECEPTACLE J 52
TERMINAL ARRANGEMENT OF RECEPTACLE J 53
TERMINAL ARRANGEMENT OF RECEPTACLES J 54 AND J 55
TO REC. RACK
HEATER
KEY
SYNJECT
GROUND
SOURCE +
GROUND
WHITE BLACK
POWER SOURCE
24-28 VOLTS
DYNAMOTOR
TONE OSC.
MODULATOR
VOLTAGE REGULATOR
SOURCE +
MIC
METER +
METER -
NO. 1 SEL.
NO. 2 SEL.
NO. 3 SEL.
NO. 4 SEL.
SEE NOTE 3
NOTES ON SWITCHES S 50, S 52 AND S 53
THE NUMBERS ON THE VARIOUS CONTACTS REFER TO THE POSITIONS OF THE SWITCH LEVERS AT WHICH THESE PARTICULAR CONTACTS ARE CLOSED BY THE ACTION OF THE SWITCH. ON S 50, "TONE" IS 1, "CW" IS 2, AND "VOICE" IS 3.
S 53 SHOULD ALWAYS BE KEPT IN "IN OUT" POSITION AS INDICATED ON THE RED PLATE FOR SATISFACTORY OPERATION WITH MICROPHONE T 17, T 30 OR EQUAL.
NOTE ON MICROPHONE JACK J 65
THE KNURLED NUT IS USED TO GROUND THE SLEEVE OF JACK J 65 WHEN A MICROPHONE EQUIPPED WITH A PUSH-TO-TALK SWITCH, SUCH AS MICROPHONE T 17, IS USED. WHEN THE JACK SLEEVE IS NOT GROUNDED, THE PUSH-TO-TALK FUNCTION MUST BE PERFORMED BY KEY K 56 OR AN EXTERNAL KEY OR SWITCH CONNECTED TO JACK J 66.
RADIO CONTROL BOX
BC-451-A
KNURLED NUT
MIC. JACK
KEY JACK
TRANSMITTER SELECTION


TYPICAL RADIO TRANSMITTER
BC-696-A(3-4 MC), BC-457-A(4-5.3 MC), BC-458-A(5.3-7 MC) OR BC-459-A(7-9 MC)
RACK FT-226-A (TWO TRANSMITTERS)
SECOND TRANS CONNECTS HERE
TERMINAL ARRANGEMENT OF RECEPTACLES J 60 AND J 61
* NOTE ON SWITCH S 54
SWITCH S 54 AND CONNECTIONS SHOWN IN DASHED LINES WERE PROVIDED IN EARLIER MODELS OF ANTENNA RELAY UNIT BC-442-A. LEAD "A" WAS LEFT OUT IN UNITS WHERE S 54 WAS USED.
ANTENNA RELAY UNIT
BC-442-A
ANTENNA TUNING
ANTENNA COUPLING
MASTER OSC.
R-F POWER AMP.
RESONANCE INDICATOR
R-F POWER AMP.
ANT
REC

NOTES:

1. ALL RELAYS ARE SHOWN IN THE NON-ENERGIZED POSITION.
2. ALL COUPLING PLUGS AND RECEPTACLES SHOWN AS VIEWED FROM THE OUTSIDE. ALL PLUGS AS VIEWED FROM THE CORDAGE END HAVE THE SAME ORIENTATION OF CONDUCTORS AS THAT SHOWN HERE FOR THEIR RESPECTIVE RECEPTACLES.
3. TRANSFORMERS T 50 AND T 52 IN MODULATOR UNIT BC-456-B ARE PROVIDED WITH SIDETONE TAPS FOR LOW IMPEDANCE HEADSETS. T 50 AND T ON T 52L. MODULATOR UNITS BC-456-A AND BC-456-B ARE NORMALLY FURNISHED WITH CONNECTIONS SHOWN IN SOLID LINES FOR USE WITH HIGH IMPEDANCE (8000 OHMS) HEADSETS. MODULATOR UNIT BC-456-B CAN BE CHANGED FOR USE WITH LOW IMPEDANCE (600 OHMS) HEADSETS BY SUBSTITUTING CONNECTIONS SHOWN IN DASHED LINES.
4. TERMINAL NUMBERS APPEARING ON RECEPTACLES OF JACK J 51 IN MODULATOR UNIT AND J 64 IN TRANSMITTER AND ALL CIRCUIT SYMBOLS ARE FOR REFERENCE PURPOSES ONLY. THEY DO NOT APPEAR ON THE EQUIPMENT.
5. * DISCONTINUED ON LATER EQUIPMENTS.

CAPACITORS

SYMBOL	MICROFARADS
C 50	.006
C 51(A,B,C)	.05/ .05/ .05
C 52	.006
C 53	.1
C 54(A,B)	.5/ .5
C 55	.1
C 56(A,B)	.5/ .5
C 57	.05
C 58(A,B,C)	.05/ .05/ .05
C 59	.0001
C 60	NO PADDING
C 61	.006
C 62	FIXED NEUTR
C 63	NO TUNING
C 64	.002
C 65	NA TUNING
C 66	.01
C 67	NA PADDING
C 68	.000005
C 69	.00005

INDUCTORS

SYMBOL	DESCRIPTION
L 50	RF CHOKE APPR
	15 MICROHENRIES
L 51	17 HENRIES
L 52	ANT TUNING
	INDUCTOR

RELAYS & KEYS

SYMBOL	DESCRIPTION
K 50	DYNAMOTOR INPUT
K 51	SIDETONE, VOICE AND TONE
K 52	DYNAMOTOR HIGH VOLTAGE (KEYING)
K 53	TRANSMITTER SELECTOR
K 54	TRANSMITTER OUTPUT
K 55	ANTENNA SWITCHING REC TO TRANS
K 56	BUILT-IN KEY

RESISTORS

SYMBOL	OHMS
R 50	62
R 51	100,000
R 52	300,000
R 53	91,000
R 54	360
R 55	2000
R 56	1300
R 57	390
R 58	51,000
R 59	30,000
R 60	75,000
R 61	20
R 62	10,000
R 63	20,000
R 64	100,000
R 65	15,000
R 66	510
R 67	51,000
R 68	20
R 69	1,000,000
R 70	1000 FOR BC-457-A
R 70	1000 FOR BC-458-A
R 70	1500 FOR BC-459-A
R 70	1500 FOR BC-696-A
R 71	176
R 72	5,000
R 73	10,000 FOR BC-457-A
R 73	15,000 FOR BC-458-A
R 73	5100 FOR BC-459-A
R 73	5100 FOR BC-696-A
R 74	15,000
R 75	5,000
R 76	20
R 77	390
R 78	51

SWITCHES

SYMBOL	DESCRIPTION
S 50	CHOICE OF EMISSION
S 51	MAIN "ON-OFF"
	BATTERY LINE
S 52	TRANSMITTER SELECTION
S 53	SHUNTS MIC SERIES RESISTOR ANT CURRENT METER SWITCHES
S 54	

TRANSFORMERS

SYMBOL	DESCRIPTION
T 50	TONE OSC
T 51	MICROPHONE
T 52	MODULATION
T 53	MASTER OSC
T 54	TRANS OUTPUT
T 55	ANT CURRENT

MISCELLANEOUS

SYMBOL	DESCRIPTION
TC 50	THERMOCOUPLE
M 50	ANT CURRENT INDICATOR (LOCAL)
Y 50	CRYSTAL UNIT
F 50	60 AMP FUSE
F 51	80 AMP FUSE
RL 50	PARASITIC SUPPRESSOR
RL 51	PARASITIC SUPPRESSOR

FIGURE 27 — RADIO SET SCR-274-N TRANSMITTING EQUIPMENT (INCLUDING MODULATOR), SCHEMATIC CIRCUIT DIAGRAM

MODIFICATION OF BC-457 TO 80 METERS AND BC-458 TO 40 METERS

The popularity of the SCR-274N series of Aircraft Command Transmitters has resulted in a scarcity of the units, particularly those covering 40 and 80 meters. The intermediate ranges, BC-457 4 to 5.3 Mc. and BC-458 5.3 to 7 Mc. are available from stock and with the following simple modification will operate successfully as either a VFO or transmitter on 80 and 40.

If you do not already have a copy of our article "Conversion of the SCR-274N Transmitters", send 10¢ to cover mailing and handling and we will mail it along to you. This article has a complete circuit diagram, power supply suggestions, and keying hints that will prove helpful.

MODIFICATION OF BC-458 TO 40 METER USE

Method 1 (Note: This method will not operate with the calibrated scale.)

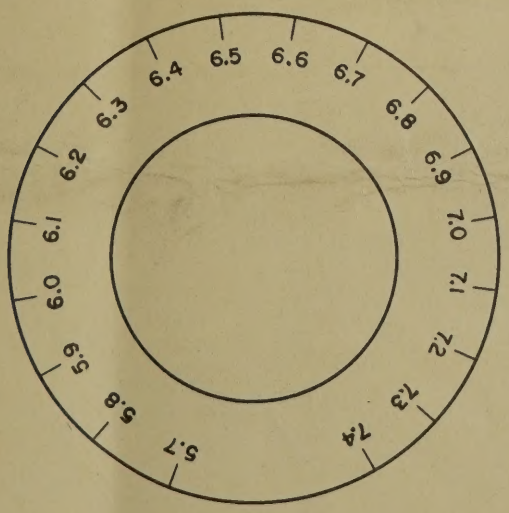
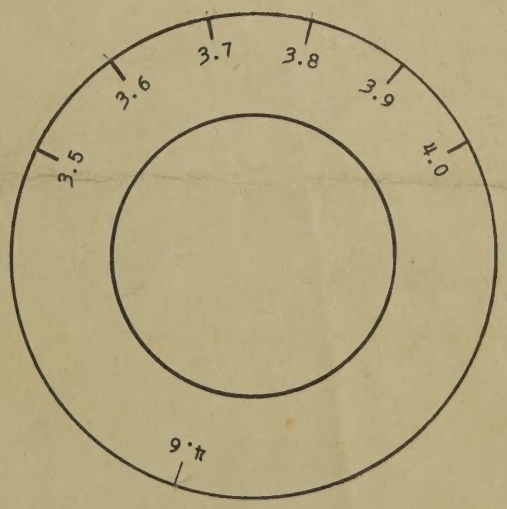
1. Remove oscillator shield can.
2. Loosen the two locking arm set screws from padder condenser shaft, using proper size bristo wrench.
3. Drill a ¼" hole in shield can 9/16" below bottom edge of locking arm access hole.
4. Temporarily replace shield can with several screws, apply voltages to oscillator and adjust large padder section to 7.4 mc (or highest frequency desired - 7.425 mc will take care of the 10 meter band) with dial set at 7.0 mc. This adjustment requires moving condenser shaft several degrees counter-clockwise.
5. Remove shield can and tighten locking arm set screws.
6. Replace shield can and securely tighten all screws.
7. Place a milliameter in final amplifier plate lead and adjust amplifier padder for plate current dip.

Method 2

1. Remove shield can and short out 1 turn at top of oscillator coil.
2. Turn iron core to within one turn of completely in.
3. IMPORTANT: Replace oscillator shield can tightly now.
4. Adjust oscillator trimmer for 7.4 mc with the dial set at 7.0.
5. Set dial at 5.8 and trim with iron core until resonance is indicated in the magic eye (6200 kc.).
6. Repeat 4 and 5 several times to insure tracking.
7. Short one turn at top of amplifier tank coil and turn slug to within two turns of completely in.
8. Set dial at 7.0 and tune amplifier padder for plate current dip.
9. Set dial at 5.8 and tune iron core in amplifier tank for current dip.
10. Repeat operation 8 and 9 several times until minimum plate current does not vary more than about 4 ma. from one end of dial to the other.

Carefully cut out the chart below and paste it to the dial for calibration of the new range.

MODIFICATION OF BC-457 TO 80 METER USE

1. Remove shield can over oscillator coil.
2. Remove connection at top of coil and add four turns of insulated hook-up wire closely spaced, connecting end of wire to condenser lead.
3. Replace shield can.
4. Set dial to 5.1 and adjust iron core until magic eye indicates resonance at the crystal frequency, 4.6 mc.
5. Set dial to 4.0 and trim to 3.5 mc. with padder condenser.
6. Repeat operation 4 and 5 several times to insure proper tracking.
7. Add 4 turns to top of amplifier tank coil and insert a milliameter in plate supply line.
8. Adjust amplifier padder to resonance as indicated by plate current dip.
9. If amplifier plate current variation exceeds 3 ma. from one end of dial to the other, adjust amplifier padder for minimum variation between 3.5 and 4 mc.

Carefully cut out the calibration chart below and paste it to the dial for calibration of the new range.